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CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Theorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

> "per litora spargite muscum,
> Naiades, et circum vitreos considite fontes:
> Pollice virgineo teneros hic carpite flores:
> Floribus et pictum divæ replete canistrum
> At vos, o Nymphæ Craterides, ite sub undas,
> Ite, recurvato variata corallia trunco
> Vellite muscosis e rupibus, et mihi conchas
> Ferte, Deæ pelagi, et pingui conchylia succo."
>
> *N. Parthenii Giannettasii* Ecl. 1.

No. 37. JANUARY 1881.

I.—*Spolia Atlantica: Contributions to the Knowledge of the Changes of Form in Fishes during their Growth and Development, especially in the Pelagic Fishes of the Atlantic.* By Dr. C. F. LÜTKEN[*].

I.

In this memoir I furnish a series of contributions to the knowledge of the ichthyological fauna of the high seas, principally of the Atlantic, as also to that of the hemimetamorphoses of various sea-fishes, and especially of the pelagic fishes. The changes of form and of other characters which many fishes present during their growth and development are still but little known, and have never been described in a connected manner, although in many cases they are so great and so strongly marked that they have given rise to the establishment of a considerable number of species and genera, which, as a matter of course, will disappear from the system so soon as their true relationships have been recognized. This memoir is, at the same time, to be regarded as an attempt on the part of the author to employ scientifically a portion of the abundant materials, consisting of small fishes and young forms, especially pelagic, which, during a long series of years and by means of well-directed and persevering efforts, have been collected by Danish naturalists and by officers of the Danish royal and commercial navies. Of course, whenever I have thought it necessary for completing my investigations and making comparisons with analogous cases, I have also studied the changes produced by age in non-pelagic fishes; and equally, of course, the criticism of the genera and species to which this study has given rise has led to discussions and digressions of various nature, as also to the creation of some new species and genera. It follows that, while this memoir is especially a contribution to the knowledge of the pelagic ichthyological fauna, particularly of the intertropical Atlantic, it is also indirectly a contribution to that of the ichthyology of the deeper strata of the high seas; for the inhabitants of these depths, in the first phases of their development, very frequently ascend, especially during the night, into the warmer strata of the surface; and they are then taken in the net; or, when they are a little older, we meet with them in the stomachs of dolphins, or of voracious fishes such as the dorados, bonitos, albacores, barracoutas, sharks, &c. But the principal object of this memoir is to call attention to what I call the *hemimetamorphoses* of fishes, a phenomenon of which the pelagic fishes in particular present so many remarkable examples. In adopting this expression it is not, however, my intention to introduce into science a new notion or a new term; I employ it solely to characterize briefly the changes which are produced during growth and development, which in many cases are so considerable that they have led to the complete misunderstanding of the genus, nay, often even of the family to which the young individuals belong. I hope by this means to profit science by a series of rectifications consisting in great part in the reduction of genera and species which are based only upon young, transitory forms. In many cases I shall thus be led simply to confirm or extend the observations of my predecessors, in other cases to reject or rectify conjectures or combinations which are destitute of foundation. One of the consequences of a work of this nature may perhaps also be that, in future, we shall proceed with more circumspection and critical judgment in establishing new species and genera, considering the possibility that the differences which may be recognized are due solely to differences of age. The mistake has only too often been made of regarding the latter as specific or generic differences; and this, in general, has rendered the estimation of the true distinctive characters all the more difficult.

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[*] Translated by W. S. Dallas, F.L.S., from a copy sent by the author of the French summary of Dr. Lütken's memoir, read before the Academy of Sciences of Copenhagen.

In the following summary of the principal facts and results which are set forth in my memoir, I have followed the order of the chapters in the Danish text.

1. DACTYLOPTERUS and CEPHALACANTHUS.

As is well known, M. Canestrini has endeavoured to prove that *Cephalacanthus spinarella* (*Pungitius pusillus*) is the young form of *Dactylopterus*. This opinion was apparently well founded; but it has been contested by M. Steindachner, principally with the argument that we may meet with *Dactylopteri* a little smaller than the largest of those which still present the characters of *Cephalacanthus*. Having had at my disposal, on the one hand, a series of twenty-five specimens of *Dactylopterus volitans* of all sizes, from 380 to 47 millims. in length, the last with the wings still short, and, on the other hand, almost as many of *Cephalacanthus spinarella* (twenty-three), also of all sizes, from 49 to 8 millims. long, I have studied in these two series all the characters subject to modifications arising from differences of age, in order to discover whether the changes which the *Cephalacanthi* had undergone enabled us to ascend to the *Dactylopteri*, and reciprocally those of the latter to descend to the *Cephalacanthi*, or whether these fishes constituted two series of forms independent of each other. The result of these comparisons (for the details of which I must refer the reader to the Danish memoir) has been, so far as I am concerned, an absolute confirmation of M. Canestrini's hypothesis. We may certainly find *Cephalacanthi* a little larger than the smallest *Dactylopteri*; but this is easily explained by the fact that the metamorphosis properly so called, which no doubt takes place comparatively quickly, does not always occur precisely when the young fish has attained a definitive length (about 50 millims.), but may, according to circumstances, occur in a given individual a little sooner or a little later. It may be added that the localities (latitude and longitude) where our young *Dactylopteri* or so-called *Cephalacanthi* were taken seem to prove that this genus possesses the character of a semipelagic genus in a greater degree than has hitherto been supposed. It appears also, from the investigation that I have made of its development, that the small anterior part of the pectoral fins in *Dactylopterus* is, properly speaking, the superior and not the inferior part, as has hitherto generally been stated.

2. RHYNCHICHTHYS, RHINOBERYX, and RHAMPHOBERYX; HOLOCENTRUM and MYRIPRISTIS.

The hypothesis has already been advanced that *Rhynchich-*

thys pelamidis, C. & V., and other species of *Rhynchichthys* subsequently established are young *Holocentra* (or *Myripristes*); and the correctness of this view is now confirmed by the circumstance that it has been possible to refer several small examples of "*Rhynchichthys*" and "*Rhinoberyx*" of different ages, fished in the western part of the intertropical Atlantic, to a definite species of *Holocentrum*, the *H. marianum* of the Antilles, which, however, has hitherto been very imperfectly described. We are acquainted with it now in all the phases of its development:—as the true *Holocentrum*, young and adult; as "*Rhinoberyx*," a phase intermediate between the *Holocentrum* and the "*Rhynchichthys*;" and, finally, in this last and very young state.

In the Danish memoir I have described in much detail the characters of the species in each of these phases, comparing them both among themselves and with the corresponding states of *Holocentrum sogho*, another common West-Indian species, of which we possess an almost equally complete series of forms. The "*Rhamphoberyx*" is probably the corresponding young form of *Myripristis*. These three genera (*Rhynchichthys*, *Rhinoberyx*, and *Rhamphoberyx*) must therefore be suppressed, with the species belonging to them; and we may say the same of certain species such as *Holocentrum platyrhinum*, which are also young forms of which the transformation is not completed, but which, instead of being referred to separate genera, have only been placed in a special group of the genus *Holocentrum*.

But at the same time I have been able to recognize a phase of development anterior to that which serves as the basis of the genus *Rhynchichthys*. A small fish, 7 millims. long, which is undoubtedly the young form of a West-Indian *Holocentrum*, perhaps even of *H. marianum*, is distinguished from the true "*Rhynchichthyes*" by a forked beak, the comparatively great length of which is equal to twice the diameter of the eye, and by the occipital spine, which is very strongly developed, as well as those of the præoperculum, which last extend much beyond the ventral fins, as far as the middle of the anal. Our museum possesses very young larvæ of Berycidæ (that is to say *Rhynchichthyes*) from the Indian Ocean, which much resemble the preceding form; but in others, which otherwise have an analogous structure, the beak, which is sometimes comparatively short and sometimes extremely elongated, does not present the remarkable division in the form of a fork. Considering the numerous representatives of this family in the Indian seas, it is impossible at present to determine these young forms more exactly.

The primordial but transitory characters which distinguish the young *Holocentra* and *Myripristes* are therefore:—1. The more or less excessive prolongation of the bones of the snout in the form of a pointed beak, entire or cleft in two, with denticulated edges, and comparatively as large as the sword of the swordfish; and 2. The colossal development of the occipital and præopercular spines, as also, in part, of those of the operculum. These spines, however, soon disappear or become reduced to more modest proportions, or to perfectly insignificant rudiments.

3. TETRAGONURUS.

This very characteristic genus, which is thoroughly pelagic and probably bathyphilous, inhabits the Atlantic, where it is frequently found in the stomachs of large voracious fishes or dolphins; and young individuals are often taken by the net. *Tetragonurus atlanticus*, Lowe, is certainly specifically identical with *T. Cuvieri*, K. The differences they present are in part purely individual, in part differences arising from age. Young individuals (32–62 millims.), leaving out of consideration certain modifications in the relative proportions of the parts of the body, which are mentioned in detail in the Danish memoir, are distinguished (1) by the spinous or denticulate opercular and præopercular bones, and (2) by the different character of the scales, which much resemble those of the young swordfish, and have only a single sharp keel (the scales of the lateral line, however, have two), which terminates in two or three spines recurved backward, giving the young *Tetragonurus* a rough or villous aspect. The youngest examples (16 millims.) have neither scales nor spines on the skin; and their ventral fins are extremely short, nay, even rudimentary. I have also discussed the question of the place to be assigned to *Tetragonurus* in the true natural system. We shall seek in vain for indications of relationship with *Mugil* or *Atherina*; the proposition of Lowe and Swainson to refer it to the Scomberoids is perhaps that which is most in accordance with nature.

4. XIPHIAS and HISTIOPHORUS (TETRAPTURUS).

The young forms of the Xiphioids are already so well known, thanks especially to Dr. Günther's communications, that the series of small individuals of the two types that I have had at my disposal do not enable me to add much that is new; nevertheless I have been able to carry the evolution of the two groups a little further, to a phase which must be very near the exclusion from the egg. The two principal types (*Xiphias* and *Histiophorus*) differ from each other quite as much in their youth as at a later period in the external characters and the structure of the skeleton. I have already shown elsewhere (Vidensk. Medd. f. d. naturh. For. 1875) that of these two types the *Histiophori* represent the typical group properly so called, or the central group, whilst the *Xiphiæ* must be regarded as a divergent branch or "aberrant type," and that the species, so far as one can form an opinion upon this point from the data furnished by the literature, seem to be few in number, less numerous, in fact, than has hitherto been supposed, but that they are almost cosmopolitan in their geographical distribution. Probably we know only five in all—namely, two *Tetrapturi*, two *Histiophori*, and one *Xiphias*. *Machæra*, C. & V., is in every respect a true *Histiophorus* without ventral fins; and we cannot help suspecting that the asserted absence of the latter is founded upon an error or due to the preparer. The small species of *Histiophorus* which have been established, *H. immaculatus*, Rüpp., and *H. pulchellus*, C. & V., are evidently only young forms (they measure respectively 18 and 4 inches), of no true specific value; and *H. pulchellus* particularly closely approaches the young *Histiophori* of 5½ to 60 millims. length, examined by Dr. Günther and by myself. For these last I refer the reader to the Danish text, the most important facts relating to them being already known; but some remarks upon the young *Xiphiæ*, and upon the characteristic differences which distinguish them from the young *Histiophori*, will be necessary. Thus, one of our young swordfish (*Xiphias*) 190 millims. long, found in the stomach of an albacore, and consequently imperfectly preserved, has a very slender form; the mandible is only 12 millims. shorter than the rostrum, which is convex above and flat beneath, like that of a *Tetrapturus*, and twice as broad as high; the branchiæ present nothing remarkable, and consequently have not yet acquired the character which distinguishes those of the Xiphioids. The two jaws are well armed with comparatively strong teeth. All the body (including the head and the rostrum) is clothed with non-imbricated scales, which are keeled and ciliated—that is to say, furnished with spines or teeth upon the keel. Two rows of these scales, which strike one by their size, extend along the back on each side of the dorsal fin, and two others along the belly on each side of the anal fin. The scales are still very distinct in the young *Xiphias gladius* 700 millims. long, in which one may even easily recognize and trace the rows of large scales above mentioned; on the other hand, this covering, at least as regards the teeth of the scales, occurs even in the youngest

Xiphias observed, 10 millims. in length. In contrast to this, all the young *Histiophori*, from 5½ to 100 millims., are completely naked and destitute of scales. Thus we cannot compare with the scales of the young *Xiphiæ* those of the adult *Histiophori* and *Tetrapturi*, which are perfectly homologous with those of the Thynnoids. The young examples of *X. gladius*, from 37 to 57 millims., are adorned with transverse bands, like many other small Scomberoids; the frontal margins and the præoperculum are denticulated; and the latter is also, in the youngest individuals, furnished with a group of spines, as in many other young Scomberoids. We never find in them any traces of ventral fins, whilst these are never wanting in the *Histiophori*, and always occur, in a rudimentary state, even in the youngest. Then, in the youngest *Xiphias*, the head is flat without presenting the sudden depression of the forehead which characterizes the *Histiophori*, the rostrum is short, and broad at the base, and the mandible as long as the upper jaw. Finally, the *Xiphiæ*, in all their successive stages, present nothing comparable to the occipital and præopercular spines, so enormously developed in the young *Histiophori*, and which resemble those of the *Dactylopteri*.

It would be far from natural to exclude the Xiphioids from the great family Scomberoidei, in which they find their most strongly marked affinity in the genus *Acanthocybium* (*vide infrà*, p. 12). The more detailed classification of the Scomberoidei has still to be settled. As to ranging them with Cottoidei ("Cotto-Scombriformes") I have never been able to convince myself that there was any thing just and natural in that classification.

5. Trichiurus and Gempylus.

Under the denomination of Trichiuridæ Dr. Günther has united two tribes which are certainly related in a certain degree, but which nevertheless are clearly distinguished from each other. These are the true Trichiuridæ (*Trichiurus*, *Lepidopus*, *Aphanopus*, and *Euoxymetopon*) and the Gempylidæ or Thyrsitidæ (*Gempylus*, *Prometheus*, *Epinnula*, *Nesiarchus*, *Nealotus*, and *Thyrsites*). The latter must be united with the Thynnidæ, but may nevertheless form a secondary group among them.

With regard to the genus *Trichiurus* I will, in the first place, remark that the species that it includes at present do not all appear to me capable of being maintained; but I shall not pronounce a definite opinion upon this point, as the materials at my command are insufficient. It is evident that the two types represented by *T. lepturus* and *T. muticus* differ in a whole series of well-marked characters, but that the generic separation between the *Lepturi* (*Trichiurus lepturus* and the allied species) and the *Eupleurogrammi* (*T. muticus*) proposed by Gill is unnecessary, and therefore to be rejected. The specific difference between *T. lepturus* of the Atlantic and *T. haumela* of the Indian Ocean seems to me not to repose upon a very solid basis; and how far the latter is really a species distinct from *T. savala* is a question which I shall also leave undecided. But there are two points which merit attention, namely:—1, that *T. muticus* also occurs in the Atlantic, where it had not hitherto been indicated (I have before me a specimen from Cuba which I am unable to distinguish from those from Tranquebar); and 2, that in a *Trichiurus* (*haumela?*) 52 millims. long, from Java, I have found, in the place of the ventrals, which are usually deficient, two denticulated spines 2 millims. in length (just as, for example, in the young *Prometheus atlanticus*). These spines, which evidently represent the ventrals, probably exist in all the young *Trichiuri*; but they persist only in *T. muticus*, in the shape of small rudiments in the form of scales, and disappear entirely in the other species.

The Gempylides and the Thyrsitides present an osteological peculiarity which has generally passed unnoticed; I refer to a system of dermal ribs, or subcutaneous accessory ribs, composed of delicate bony filaments, placed pretty close together, which are directed backwards, and both upwards and downwards, and start from the median line on both sides of the body, forming acute angles with each other. I have observed them in *Thyrsites atun* (*chilensis*), in *Nealotus tripes*, and in both large and small examples (down to a total length of 78 millims.) of *Gempylus serpens*. I have been able to study the last-named species, which is essentially pelagic and rare in museums, in all the phases of its development, from a length of about 1 metre down to a total length of only 9 millims., a phase which must have almost immediately succeeded the hatching of the egg. The species established, namely *G. coluber* (genus *Zyphothyca* of Swainson) and *G.* or *Prometheus* (*Nealotus*) *ophidianus*, Poey, do not differ specifically from *G. serpens*; but the characters of this genus are not correctly indicated, even in the most recent works. Thus the skin is not entirely destitute of scales: we find in it a rudiment of the "corselet," not only behind the eyes, but also at the root of the tail; and from this point the clothing of scales continues in part for a small extent along the inferior lateral line, in part for a greater extent along the back, forming a band which is limited inferiorly by the superior lateral line, which in the anterior part of the body unites with the inferior, at a point situated beneath the first dorsal spine. The palatine bones in their posterior part are armed each with three or four small teeth; and the ventrals are formed by one spinous and four soft rays. In the earliest phases of their development the *Gempyli* have so different a physiognomy that it would be difficult or impossible to recognize them for what they are if one did not know the intermediate stages. The body is short and thick-set; the first dorsal attains its greatest elevation in front, and then decreases rapidly; we find two free spines in front of the anal fin; the denticulated spines of the ventrals are comparatively very long, as long as (and even longer than) the spines of the dorsal; there are neither scales nor lateral line; nor are the finlets distinguishable; the operculum and præoperculum are spinous. For what relates to the course of the development and transformation I refer the reader to the figures on pl. iii. [of the Danish memoir]. I have also described and figured some very analogous stages of development in a fish of the *Thyrsites* tribe, perhaps *Nealotus tripes. Dicrotus armatus*, Günther, is certainly an analogous transitory form, probably of *Prometheus atlanticus.*

6. THYNNUS; ORCYNUS; PELAMYS; CYBIUM and ACANTHOCYBIUM.

In the group Thynnidæ I distinguish the following genera:— *Orcynus, Thynnus, Auxis, Orcynopsis, Pelamys, Cybium*, and *Acanthocybium.* I must leave on one side certain other genera which have been established, because I do not know them— for example the genera *Grammatorcynus*, Gill (*Thynnus bilineatus*), *Lepidocybium* and *Apodontis*, Benn.; the separation of these two last genera from *Cybium* seems to me, however, to be not well founded. *Gymnosarda* Gill (*Pelamys nuda*) will no doubt prove to be a synonym of *Orcynopsis*, G. (*Pelamys unicolor* = *Thynnus peregrinus*, Coll.*); even the specific differences which serve as the basis of these two genera are rather uncertain, and will need to be confirmed, although one of the two species is a native of the Mediterranean (it has been once found in the North Sea) and the other of the Red Sea.

I retain the name of *Thynnus*† for "the small tunnies," the bonito (*T. pelamys*) and *T. thunnina*, a species from which *T. affinis* probably does not differ; and I reserve that of *Orcynus* for "the large tunnies"—that is to say, the true tunny (*O. thynnus*) and the "germon" or albacore of our sailors (*O. germo*), a species which is rendered recognizable by the long pectorals and the prolongation in a sabre-like form, in the adult, of the second dorsal and the anal. These four species are all extremely cosmopolitan in their geographical distribution (which also seems to be the case, although in a less degree, with *Auxis*); those of the whole group which have the pelagic character most strongly marked are *Orcynus germo* and *Thynnus pelamys*. A critical revision of the species described under other names, a revision founded on the comparison of individuals of different sizes belonging to several of the four principal types above mentioned, has convinced me, or at least rendered it very probable, that most of these species must be eliminated, as resting only upon quite secondary differences, to a great extent arising from age. Thus *T. brachypterus* is without the least doubt nothing but a young form of *Orcynus thynnus*, and *T. brevipennis* a still younger form of the same, or rather a corresponding form of *T. thunnina*. I must here remark that the want of the swimming-bladder, which is generally attributed to the true tunny, is apparently founded on a mistake; it is described in detail by M. Malm in his 'Fauna of Bohuslän.' Further, I have no hesitation in identifying *Thynnus secundodorsalis*, Storer, and *T. orientalis* from Japan with *O. thynnus*; *Thynnus coretta* is a form intermediate between *Orcynus thynnus* and *T. brachypterus*, and may consequently also be struck out of the catalogue. With *Orcynus germo* (*pacificus*), again, I identify *T. alalonga*, *albacora*, *argentivittatus*, *balteatus*, *sibi*, and *macropterus*, which inhabit different parts of the great ocean; but I hesitate about including in this suppression of species *O. subulatus*, Poey, of Cuba, and *O. pacificus*, Cooper, of California,—the former on account of its pectorals, which are singularly short for an albacore; the latter, on the contrary, on account of extraordinary prolongation of these same fins. At any rate the characters ascribed to these two forms of albacores require confirmation in this respect. As to the generic separation of the albacores, with long pectorals, from the true tunnies, with shorter pectorals, there seems at present no reason for making it. From these forms, which I unite under the generic denomination of *Orcynus*, the "small tunnies" (*Thynnus* s. str. m.) differ:—1, by the absence of teeth on the vomer, a character which has hitherto passed entirely unnoticed, but to which, in the group of the Thynnidæ, generic value has generally been accorded; 2, by the complete absence of scales outside the corselet, whilst in the *Orcyni* of the same size the skin is already clothed with small scales, the consequence of which is that the limits of the "corselet" in the adult tunny and albacore are somewhat obscure, so that, properly speaking, we cannot say there is a distinct corselet in those species; 3, by an important osteological character, namely the special development, in the form of a net or trellis, of a portion of the abdominal part of the vertebral column between the vertebræ properly so called and the hæmapophyses, a development which has already been described by Cuvier. This organization is common to *T. thunnina* and *T. pelamys*, and occurs in a modified form in *Auxis*, while in this respect *Orcynus germo* presents essentially the same character as *O. thynnus* and the species belonging to the genera *Cybium* and *Pelamys*. Whether this is or is not the case in *Orcynopsis* (*unicolor*) is unknown; but there is reason to suppose that it presents some of the characters belonging to *Auxis* and to *Thynnus* (m.).

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* M. Giglioli has recently proposed for this genus the name of *Pelamichthys*, which, however, must yield priority to that proposed by Mr. Gill.

† M. Giglioli designates this generic division by the name of *Thynnichthys*, a very happy denomination, but one which has already been employed for a genus of Cyprinoids.

Pelamys chilensis and *P. orientalis* are certainly not different species, any more than *Thyrsites chilensis* and *T. atun*. It is by error also that a corselet of scales has been denied to the genus *Cybium*; this is already distinct in very young individuals, and extends, in the usual way, round the base of the pectorals and ventrals, along the dorsals, &c.; but, it is true, it is less apparent than in the other Thynnoids. The species included in the genus *Cybium* differ in general by rather insignificant characters, which, however, seem to be more constant than might have been expected. There is therefore no reason for reducing them in the same proportion as the species of the *Thynnus-Orcynus* group; moreover it would appear that they are far from being so pelagic as the species belonging to the latter group. Among the species of *Cybium* proper inhabiting the Atlantic, I have been able to distinguish without difficulty *C. caballa* (of which *C. immaculatum* is no doubt the young form), *C. regale*, and *C. maculatum*; *C. acervum* is a young *C. regale*, and has nothing to do with *C. caballa*.

There is, however, a species of *Cybium* which must be generically separated from the rest, namely the large truly pelagic and rather rare Thynnoid, attaining a length of more than seven feet, which our sailors call the "barracotta," and of which they have sometimes brought us the head and caudal fin; it is met with in the Atlantic north and south of the equator, in the Mediterranean, and in the Pacific Ocean, but much more rarely than the bonitos and albacores. It is the

Cybium Solandri, C. & V., *C. petus*, Poey, the type of the genus *Acanthocybium*, Gill, and recently described by M. Doderlein under the name of *C. Verany*. This genus is clearly distinguished from the true *Cybium* :—1, by the long and pointed form of the head, in which the mandible is longer than the upper jaw, the cleft of the mouth reaches only to beneath the eye, and the posterior part of the maxillary is not visible but concealed by the suborbital plate; the jaws are armed with a close series of cutting-teeth lancet-shaped and finely crenulated; 2, by the branchiæ, which exactly resemble those of *Xiphias*, their leaves being soldered together in the form of a network; 3, by the distance between the points of the caudal fin, which scarcely exceeds the length of the head, &c. That *Acanthocybium* is the Thynnoid form most nearly approaching the swordfish is shown by the peculiar modification of the branchiæ and the prolongation of the intermaxillaries, which, if more developed, would become the short rostrum of *Tetrapturus belone*. This genus thus acquires peculiar importance from a systematic point of view; and a detailed investigation of the still unknown structure of its skeleton would be especially desirable.

I have regarded as belonging to *Orcynus germo* some small Thynnoids of 8–17 millims. long, fished in the open sea. The corselet and the keels of the tail are wanting; the finlets are only just indicated in the largest specimen, and are not distinct; there is no trace of them in the others, which are distinctly heterocercal and perfectly colourless, with the exception of the eyes and the first dorsal, which are black. The præoperculum is armed with spines in all.

7. CORYPHÆNA EQUISETIS, *L.*, C. HIPPURUS, *L.*, and C. FASCIOLATA, *Pall.*

The genus *Coryphæna* (the "dolphins," as our sailors call them) is one of those which have the pelagic character most strongly marked; at the same time it furnishes an example *instar omnium* of the extreme confusion that has resulted from the circumstance that a really very limited number of existing species has been broken up into a great number of nominal species which are based only upon differences of age and sex, upon individual peculiarities, different geographical localities, incorrect drawings, imperfect descriptions, &c., a confusion for which, however, George Cuvier has been wrongly made personally responsible. The error committed in dividing the species into two genera, *Coryphæna* and *Lampugus*, has already been rectified by a competent authority; and the number of species reputed well established has, at the same time, been reduced from nineteen to six. I have no doubt, however, that this number is still too great, and that it must be limited to two or, at the most, to three—the two old Linnæan species, "the great dorado" (*C. hippurus*), which attains a length of nearly 2 metres, and "the little dorado" (*C. equisetis*), the size of which does not exceed 2¾ feet. In the Danish text I have given comparative characters of the two species, taking into account especially the changes which they undergo with age during their growth, as well as those which, at least in *C. equisetis*, are a consequence of sex, and I have illustrated by figures the modifications which are produced in the two species in the form of the head. Most of the species described and figured by authors may, without much difficulty, be referred to the two cosmopolitan species in question, which our sailors have frequently brought us, and which are the only ones that they have been able to present to us. I must, however, speak with some little reserve of the *C. pelagica* (*azorica*, *sicula*) of the Mediterranean, which has been adopted by most of the authors who have paid attention to the ichthyology of that sea, but which, nevertheless, probably does not differ specifically from *C. hippurus*, L.; at least I was obliged to regard as a young individual of the latter species a small "*C. pelagica*" from the Mediterranean which was kindly submitted to my examination under the above name by an Italian museum. In support of my opinion, that in reality there exist only two species of *Coryphæna*, I will cite two other circumstances:—one that Dr. Günther (although he formally recognizes more) really refers all the specimens at his disposal to these two species, and thus in fact only recognizes these; the other, that I have been able without difficulty to arrange the numerous examples of young *Coryphænæ* from 18 to 62 millims. long, captured by our mariners, in two series representing two species, and to refer these series to the two species in question and to no others—namely, the more numerous one to *C. equisetis*, and the less numerous to *C. hippurus*. Further, the young *Coryphænæ* have so little resemblance to the adults in the matter of habit, that they may easily give rise to mistakes; it is thus that a young *C. hippurus* was described by Pallas under the name of *C. fasciolata*. I have given comparative descriptions of young individuals of the two species in their successive stages and in their relations to the adults; and I shall here confine myself to referring to the figures on my pl. iii., only remarking that the greater length of the ventrals in *C. hippurus*, and especially their attachment beneath the pectorals, more forward than in *C. equisetis*, furnish one of the best means of separating from each other the young individuals of the two species, and agree with one of the best distinctive characters of the adults. The very small examples of both species not only have the præoperculum furnished with spines, but they have also a scapular spine and a postsupraorbital spine on each side. The larger specimens have a rather elongate form, but are at the same time pretty thick, and not compressed as at a later period; the dorsal, which is comparatively rather low, originates, in the adult *C. equisetis*, at a point not far distant from the posterior margin of the eye, in young individuals above the posterior margin of the præoperculum, in still younger individuals between the latter and the gill-cleft, in the adult *C. hippurus* above the posterior margin of the pupil, in the youngest individuals above the gill-cleft, &c. The system of coloration which distinguishes the different ages of these two species will be easily understood by the aid of the figures.

[To be continued]

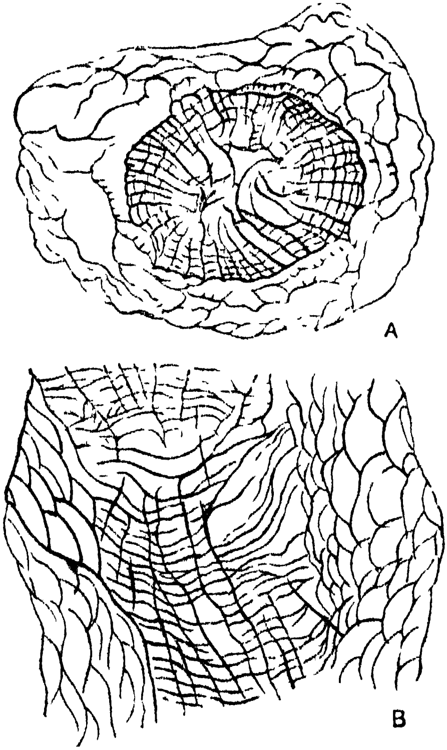
II.—*On some new or imperfectly-known Species of Corals from the Devonian Rocks of France.* By H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E.

[Plate I.]

Some little time ago M. Daniel Œhlert, the able Curator of the Museum of Natural History in Laval, was good enough to send me for examination and determination a number of corals from the inferior Devonian deposits of the neighbourhood of Laval, the stratigraphical and palæontological relations of these deposits having been made by him a subject of special study. Among the specimens contained in the collection submitted to me were some entirely new forms, as well as some which have not yet been fully worked out; and I propose on the present occasion, in accordance with M. Œhlert's wish, to give a brief description of the more important and striking of these.

Endophyllum Œhlerti, Nich.

Spec. char. Corallum composed of subcylindrical corallites, which are either not in contact at all or, at most, touch each other only at limited portions of their circumference. The diameter of the corallites along their longest axis is from 20 to 25 millims. Each corallite is enveloped in a distinct epitheca, which, though not thick, is provided with irregular, somewhat sharp-edged, closely-set annulations, and is marked with faint longitudinal or costal ridges. The exterior zone of the corallum for a width of from 3 to 4 millims. is made up



Thin sections of *Endophyllum Œhlerti*, Nich., enlarged rather more than twice. A. Transverse section of a corallite, showing the outer vesicular zone and the inner tabulate area, the latter intersected by the septa. B. Vertical section of the same, showing the same two areas: the bending upwards of the tabulæ in the outer part of the inner area is here well shown, and the cut edges of a number of the septa, in the form of longitudinal lines, are also exhibited, owing to the fact that the section is slightly excentric; on the left-hand corner of the figure a part of the exterior vesicular zone has been restored.

of large-sized, irregularly-shaped lenticular vesicles, which in vertical sections (fig. B) are seen to be directed with their longest axes passing obliquely downwards from the circumference towards the internal wall. Their greatest length varies from 1 to 5 or 6 millims. The inner mural investment is well marked, and encloses a space of from 14 to 15 millims. in its greatest length, which is subdivided by a series of well-developed septa. The septa are alternately long and short, about thirty-six of each series existing in a corallite of 25 millims. width, flexuous, the longer ones extending to near the centre of the visceral chamber. Traces of vertical lamellæ also exist in the exterior vesicular zone, these representing the imperfect outward prolongation of the septa from the inner area. Dissepiments (which are really only the cut edges of the ascending tabulæ) are developed in the outer portion of the central tabulate area. The tabulæ are well developed in the central portion of the corallites, where bounded by the inner mural circle, being close-set and nearly horizontal in the middle of this region, but becoming sharply bent up towards its margins.

Obs. I have founded this species upon a single well-preserved specimen in the possession of M. Œhlert.

The specimen in question exhibits four corallites, of which two are quite separate from the others, standing at a distance respectively of 2 and 11 millims. apart from them, while the remaining two are in contact for a distance of nearly 2 centims., the one being indented by the pressure of its neighbour. Even in this case, however, the contiguity is not attended by any real union or amalgamation, the two corallites being each provided with its own distinct epitheca, and being quite readily separable from one another. The basal portions of the corallites are enveloped in the matrix; and their precise mode of origin is therefore uncertain.

As regards the internal structure, the points most worthy of notice will be readily recognized by reference to the preceding description and by the accompanying drawings of the transverse and vertical sections of one of the corallites (figs. A and B).

There can be no doubt that the present species is a true *Endophyllum*, in spite of the fact that the corallites possess a distinct epithecal investment, and that this structure is stated by Milne-Edwards and Haime to be wanting in this genus. In all the points of its internal structure, however, it entirely agrees with the other recorded species of the genus; and the development of the epitheca must therefore be taken to be a variable character. In point of fact *E. abditum*, E. & H., does possess well-developed walls to the corallites, and the absence of an epitheca is probably only due to the coalescent condition of the corallites.

From *E. abditum*, E. & H., the present species is at once distinguished by the disjunct condition of the corallites and their much smaller size.

From *E. Bowerbanki*, E. & H., the present species is separated by the fact that each of the corallites possesses a well-developed external investment, while the corallum is not astræiform.

Horizon and Locality. Inferior Devonian, Montjean, Gallois (*coll. Œhlert*).

Striatopora pachystoma, Nich.
(Pl. I. figs. 1–1 *b*.)

Spec. char. Corallum ramose, composed of cylindrical or subcylindrical branches, which have a diameter of from 5 to 10 millims. The corallites are primitively polygonal, with exceedingly distinct walls, but having the visceral chambers greatly contracted by a secondary deposit of light-coloured sclerenchyma deposited in concentric lamellæ, the amount of this thickening being greatly increased as the mouths of the tubes are approached (Pl. I. fig. 1 *a*). The size of the corallites is very variable, the largest ones having a long diameter of about 3 millims. (from wall to wall), while the smallest ones may not be much over a millimetre in width when similarly measured. The preservation of the calices in all specimens I have seen is poor; but they are not surrounded by thin and sharp margins, and tangential sections show that the diameter of the visceral chambers near their mouths varies from a millimetre and a half in the largest tubes to about half a millimetre in the smallest corallites. No septal teeth, or but very rudimentary ridges, are developed on the neck of the tubes. No traces of tabulæ are recognizable in long sections (Pl. I. fig. 1 *b*), but the walls of the tubes are seen to be perforated by a few remote and irregularly-distributed mural pores.

Obs. This species is most nearly allied to the *Striatopora Linneana*, Billings, of the Devonian rocks of Canada (see Nicholson, Tabulate Cor. of the Pal. Period, p. 100, pl. v. figs. 2–2 *d*), which it much resembles in its general aspect. It is, however, in general a coarser and more stoutly-built form, and it differs structurally from *S. Linneana*, Bill., in its want of tabulæ and in the fact that the calices are not surrounded by a thin polygonal rim. Though the external preservation of the specimens is not good, this much can be made out with certainty—the calices being always bounded by thick walls (Pl. I. fig. 1), and being in the best-preserved examples surrounded by thickened and raised circular borders, whereas in *S. Linneana* the calices have sharp-edged polygonal borders surrounding the cup-shaped apertures of the tubes. Moreover the present species appears to want the marked septal ridges which surround the throat of the visceral chambers in *S. Linneana*; and its large corallites are decidedly larger than is the case in the latter form.

Horizon and Locality. Inferior Devonian, La Baconnière, Laval, Mayenne (*coll. Œhlert*).

A very nearly allied if not identical form occurs in the Eifel; but I have not yet fully examined this.

Pachypora Œhlerti, Nich.
(Pl. I. figs. 2–2 c.)

Spec. char. Corallum forming flat or slightly undulated expansions, the under surface of which was doubtless originally covered by an epitheca, though this is no longer recognizable, and which vary in thickness from 2 millims. up to a centimetre. The upper surface exhibits the apertures of the calices (Pl. I. fig. 2 *a*)—which are very irregular in shape, but usually exhibit two strong septal teeth, one on each side. Sometimes there is only a single well-marked projection of this nature; sometimes there are three such; but in any case the actual mouths of the corallites are never regularly polygonal or circular, or even crescentic, but are always to some extent encroached upon by well-marked inward prolongations of the wall, and their most general form is perhaps rudely quadrangular. Very commonly two or more of the calices run into one another, and the calicine apertures thus become vermicular. The actual diameter of the tubes of the corallites varies from one third to two thirds of a millimetre measured along their greatest lengths; but to that must be added the thickness of the walls, so that in general about four calices are found in a space of from 2 to 3 millims. The walls of the tubes, as seen in tangential sections (Pl. I. fig. 2 *b*), are very much thickened; but no lines of demarcation between adjoining corallites can be made out. In thin vertical sections (Pl. I. fig. 2 *c*) the same thickened condition of the walls and the absence of any proper boundary between adjoining tubes can be observed. Tabulæ complete, but few in number and irregularly developed. Mural pores not observed with certainty.

Obs. This well-marked form seems to be a *Pachypora* of the general type of *P. Fischeri*, Bill., and *P. frondosa*, Nich., though it possesses marked peculiarities of its own. Its characters, in fact, increase the probability that it may be ultimately necessary to still further subdivide the genus *Pachypora*, Lindst., retaining this name for forms like *P. lamellicornis*, Lindst., *P. Fischeri*, Bill., and their allies, and creating a new genus, or subgenus, for such more natural and normal types as *P. cervicornis*, Blainv., and *P. cristata*, E. & H.

Favosites punctatus, Boullier.
(Pl. I. figs. 3–3 *c*.)

Favosites punctata, Boullier, Annales Linnéennes, 1826.

Spec. char. Corallum massive, attaining a large size, and composed of regularly prismatic corallites, which radiate very gently outwards as the periphery of the colony is approached. Corallites basaltiform, angular, and thin-walled, the average tubes having a diameter of about one millimetre and a half, but having a considerable number of smaller corallites wedged in amongst them at their angles of junction. The walls of the corallites retain their primitively duplex character. Well-marked but irregularly-developed septal spines of a blunt form and upward direction can be detected in parts of the corallum. The tabulæ (Pl. I. fig. 3 *c*) are complete, numerous, horizontal, flexuous or slightly curved, separated by interspaces of from one third to one half of a millimetre. The mural pores are numerous, closely approximated, round or oval in shape, without a raised margin, four or five being generally present in the space of 2 millims. measured vertically; their arrangement is either uniserial, or they are disposed in two subalternating rows, according to the width of the prismatic faces of the corallites.

Obs. This species seems to have been overlooked by Milne-Edwards and Haime in their great work on fossil corals (' Polypiers fossiles,' 1851); and I am not aware that it has been in any way noticed by subsequent zoophytologists. It was, however, described and figured in a perfectly recognizable manner in the year 1826 by M. E. Boullier ("Mémoire sur une espèce de Polypier fossile rapportée au genre Favosite de Lamarck," extrait des Annales Linnéennes pour 1826). I am greatly indebted to Mons. Œhlert for having furnished me with an accurate transcript of the text and figures of this rare paper; and I can unhesitatingly support the validity of M. Boullier's determination.

The two species of *Favosites* to which the present form is most closely related are *F. basalticus*, Goldf., and *F. turbinatus*, Bill. The large corallites in *F. basalticus* are much larger than in *F. punctatus*; its tabulæ are in general wider apart; its mural pores are almost always uniserial (*Edwards and Haime*, Pol. foss. p. 236); and the breadth of the corallum is proportionally greater than the height. On the other hand, in *F. punctatus*, Boullier, the corallum is higher than broad, the diameter of the largest corallites is rarely above a millimetre and a half, the tabulæ are closely set, and the mural pores are at least as commonly biserial as uniserial. From *F. tur-*

binatus, Billings, the present form is distinguished by its not assuming the remarkable shape of the former and by the want of its peculiar epitheca, as well as by the commonly biserial condition of the pores and the more closely set tabulæ.

Horizon and Locality. Abundant and well preserved in the inferior Devonian deposits of La Baconnière, Mayenne.

Favosites? inosculans, Nich.
(Pl. I. figs. 4, 4*a*).

Spec. char. Corallum forming a large mass of unknown dimensions, the single specimen examined being 12 centims. in length by 7 in width, and 4 in height. The corallites are very minute, averaging half a millimetre in diameter, and radiating gently from the base. Very commonly, in fact in a large proportion of the corallites, the walls are partially deficient; so that two, three, or four adjoining tubes may run into one another laterally in a vermiculate manner (Pl. I. fig. 4), the boundaries between the different elements of such a common tube being indicated by short marginal and opposed ridges. The line of demarcation between the sclerenchyma of any one tube and that of its neighbours is in general recognizable by the presence of a clear linear space representing the primitive wall. The tabulæ are numerous, complete, and approximately horizontal. Septal spines not observed. The mural pores are numerous, very large, closely approximated, oval or rounded in shape, and arranged in a single series on each face of a tube, six or eight pores, or more, being present in a vertical space of 2 millimetres.

Obs. In general shape and aspect this singular species is very like a massive *Alveolites* or *Chætetes*. Its corallites, however, show nothing of the compressed and often crescentic or lunate character of those of *Alveolites*, and it clearly cannot be referred to this genus. On the other hand, it presents a curious resemblance to *Chætetes* in the imperfect condition of the walls of the corallites, and the resulting presence of blunt processes or ridges extending into the visceral chambers (Pl. I. fig. 4). In *Chætetes*, however, this appearance is due to the partial division of the old tubes, preparatory to their complete fission, whereas in the present case the adult tubes simply communicate with one another by a deficiency of their parietes. That the present species is not a true *Chætetes* is also conclusively shown by the fact that the duplex character of the walls of the tubes can be clearly recognized, as well as by the presence of numerous large mural pores. This last character proves it to belong to the Favositidæ, though its reference to *Favosites* proper is rendered somewhat doubtful by the unusual thickening of the walls, as well as by the free intercommunication between adjoining corallites.

The single specimen of *F.? inosculans* that I have examined does not exhibit any part of either the upper or lower surface in its original condition; and the preservation of the corallum in a remarkably soft and splintery rock (dolomite?) renders its microscopic examination peculiarly difficult. At the same time its minute structure is quite characteristic, and sufficiently separates it from any allied type with which I am acquainted.

Horizon and Locality. Inferior Devonian, Chalonnes.

SPECIES OF CORALS ASSOCIATED WITH THE PRECEDING.

It may be of advantage if I append the following brief notes upon some of the remaining corals which were contained in the collection submitted to me by Mons. Œhlert, and which are associated with the new forms previously described.

1. *Favosites*, sp. A form like *F. gothlandicus*, Lam., in general shape, having a massive corallum composed of regularly prismatic corallites of tolerably uniform diameter, their ordinary width being about 2 millims., or rather less. As seen in tangential sections the walls are moderately thin, and no septa can be detected; but in long sections the walls are sharply undulated, or show well-marked spiniform and inwardly directed processes. The mural pores are of considerable size, sometimes uniserial, sometimes in two alternating rows on each prismatic face of a corallite. Tabulæ well developed, mostly half a millimetre or less apart.—*Horizon and Locality.* Inferior Devonian, St. Malo.

2. *Favosites gothlandicus*, Lam. Two specimens, which differ little from the ordinary Devonian examples of this species.

3. *Favosites Forbesi*, E. & H., var. (?). Corallum small, rounded, subhemispherical or spheroidal, mostly about an inch in diameter. Corallites of very unequal sizes, the larger ones averaging about 2 millims. in diameter, their walls being thick and their shape cylindrical. The smaller corallites are numerous, from rather more than a millimetre to half a millimetre in diameter, very variably shaped, but almost always angular. The tabulæ are strong, remote, and approximately horizontal, No traces of septa or septal spines detected. External surface of the tubes marked with numerous fine, slightly-curved striæ. Mural pores of large size, sometimes uniserial, sometimes in two subalternate rows on each prismatic face.

This may be provisionally regarded as a variety of *F.*

Forbesi, E. & H., from which it differs in the comparatively large number and small size of the smaller corallites. It is most like *F. Forbesi*, var. *tuberosa*, Röm.; but the corallum never attains any great dimensions, and there are no traces of the characteristic epithecal or opercular investment of the latter. From *F. Forbesi*, var. *eifelensis*, Nich., it differs in the great number of the small tubes and the apparent absence of septal spines; and from *F. Forbesi*, var. *waldronensis*, Nich., it is separated by the smaller size of the large corallites as well as by their proportionately smaller number.—*Horizon and Locality*. Inferior Devonian, Saint Jean sur Mayenne and La Baconnière.

4. *Pachypora cervicornis*, De Blainv. Numerous specimens of this form, the branches varying in diameter from 5 millims. to over 2 centims., are represented in M. Œhlert's collection. Their internal and external characters are precisely similar to those of specimens from the Eifel.—*Horizon and Locality*. Inferior Devonian, Saint Jean sur Mayenne; Mont Jean, Gallois.

5. *Pachypora*, sp. A single fragment of limestone containing numerous stems of a small *Pachypora* imbedded in it. In structure and general character this form is like *P. cervicornis*, Blainv.; but the stems are all small (5 millims. or less in diameter), and the tubes are more minute and more delicate than in the latter. It is more nearly related to *P. meridionalis*, Nich. & Eth. jun., from the Devonian rocks of Queensland; but more extended material would very probably show it to be a distinct species.—*Horizon and Locality*. Inferior Devonian, La Baconnière.

6. *Heliolites porosus*, Goldf.—*Horizon and Locality*. Inferior Devonian, Chalonnes, La Baconnière, and Gallois.

7. *Heliolites*, sp. A form resembling *H. interstinctus*, Wahl., but with larger tubes and with some less conspicuous peculiarities.—*Horizon and Locality*. Inferior Devonian, Mont Jean, Gallois.

8. *Monticulipora Winteri*, Nich. Several specimens (from the Inferior Devonian of La Baconnière), which, both in external characters and in microscopic structure, precisely agree with the examples of the Eifel. Dr. Steinmann, for whose opinion I entertain the highest respect, has suggested recently (N. Jahrb. für Min. Geol. und Pal. 1880, p. 438) that this species is really the *Favosites fibrogloboѕus* of Quenstedt, described from the same locality (Gees, near Gerolstein). I do not feel at present able to accept this conclusion, for two reasons. In the first place, I have made a careful examination of numerous specimens, both German and French, of the form which

I call *Monticulipora Winteri*, both externally and by means of microscopic sections, and I have totally failed to detect any traces of mural pores. In the second place, my own limited collections are sufficient to show me the impossibility of pronouncing positively upon the structure and affinities of any individual specimens, even of a known and marked external figure, and from a known locality, unless a microscopic examination has been instituted; and the form now under discussion is an excellent example of what I now say. I find, namely, that I possess in the collection which I personally made at Gees *three* quite distinct forms, all of which so closely resemble each other externally that, until I had made thin sections of them, I had placed them together in the same tray, as indubitably belonging to the same species. One of these three forms is the type which I have described under the name of *Monticulipora Winteri*; another is a true *Fistulipora*, as defined by M'Coy; and the third is a genuine *Alveolites*, and is provided with numerous and well-marked mural pores. The form described by Quenstedt under the name of *Favosites fibroglobosus* (Petrefact. Deutschlands, Bd. vi. S. 15, Taf. 143) is one with which I am unfortunately unacquainted; but it might, so far as external form is concerned, easily be any one of the three forms which I have just enumerated; or it might be a fourth, quite distinct form. In any case, the facts I have mentioned are quite sufficient to prove that the occurrence of a fossil at a particular locality and its possession of a well-marked external form cannot be allowed to count for any thing (so far as the more delicately constructed species of corals are concerned) when we come to determine generic or specific relations and affinities.

9. Associated with the preceding were species of *Aulopora*, *Cyathophyllum*, *Zaphrentis*, and *Cystiphyllum*, which my leisure would not permit me to specifically determine. M. Œhlert's collection also contained some interesting Stromatoporoids, which I may take the opportunity of describing on some future occasion.

EXPLANATION OF PLATE I.

Fig. 1. A fragment of *Striatopora pachystoma*, Nich., of the natural size.

Fig. 1 *a*. Portion of a tangential section of the same, enlarged seven times.

Fig. 1 *b*. Part of a vertical section of the same, enlarged seven times, showing the thickened walls and a few mural pores.

Fig. 2. A fragment of *Pachypora Œhlerti*, Nich., of the natural size.

Fig. 2 *a*. A small portion of the surface of the same, enlarged eighteen times, showing the form of the calices.

Fig. 2 *b*. Portion of a tangential section of the same, enlarged eighteen times, showing the thickened walls and the septal (?) teeth of the corallites.

Fig. 2 *c.* Vertical section of the same, enlarged eighteen times, showing the thickened walls and the remote tabulæ.

Fig. 3. A small fragment of *Favosites punctatus*, Boullier.

Fig. 3 *a.* Three tubes of the same, enlarged three times.

Fig. 3 *b.* Tangential section of the same, enlarged seven times.

Fig. 3 *c.* Vertical section of the same, enlarged seven times, showing the mural pores and tabulæ.

Fig. 4. Tangential section of *Favosites* (?) *inosculans*, Nich., showing the free communication between many of the corallites, enlarged eighteen times.

Fig. 4 *a.* Vertical section of the same, enlarged eighteen times, showing the large mural pores and the tabulæ.

III.—*Description of a new Species of* Mus *from Southern India.* By OLDFIELD THOMAS, F.Z.S., British Museum.

THE specimen here described was obtained at Kadapa, Madras, by Colonel R. H. Beddome, and has been presented to the British Museum, together with a large series of other Indian Muridæ, by Mr. W. T. Blanford, after whom I propose to name it

Mus Blanfordi, sp. n.

Fur above slate-colour, tipped with fawn; hairs rather long and soft. Belly white, sharply defined. Tail longer than head and body; basal half dark, distal half above and below white; distal third covered with soft, white, shining hairs about a quarter of an inch long, forming a pencil at the tip. Tarsus rather long. Five front and six hind foot-pads. Ears long, oval, nearly naked. Mammæ six, one pectoral and two inguinal pairs.

The skull differs from those of all other Indian rats by the front edge of the external wall of the infraorbital foramen being strongly slanting instead of perpendicular. The interparietal also is much more elongated transversely than usual.

Measurements of the type, an adult female:—Head and body (about) 4·1 inches; tail 6·1; hind foot, without claws, 1·2; forearm and hand 1·3; ear-conch, length from external base ·70, breadth ·54; skull 1·42.

IV.—*Descriptions of certain peculiar Bodies which may be the Opercula of small Gasteropoda, discovered by Mr. James Bennie in the Carboniferous Limestone of Law Quarry, near Dalry, Ayrshire, with notes on some Silurian Opercula.* By R. Etheridge, Jun.

[Plate II.]

Introduction.—The object of the present communication is to briefly describe several small bodies which Mr. Bennie and myself are mutually agreed in regarding as the opercula of minute Gasteropoda, and which were discovered by the former some time ago in a bed of highly fossiliferous and siliceous limestone near Dalry. The interest attached to these remains lies in the fact that occasionally small entire shells are found in the same stratum with one form of the opercula about to be described *in situ*, thus affording a very good demonstration of their true affinity. The description of a large *Naticopsis* with the operculum *in situ* and several examples of *Euomphalus sculptus* from the Wenlock Limestone, all contained in the British-Museum collection, will complete the account. Mr. Bennie has kindly furnished me with the following notes on the bed of limestone from which the fossils were obtained.

Law Quarry is situated on the Cubeside farm, about two miles north-west of Dalry, and only a few hundred feet from the edge of the great mass of bedded traps which stretch from Dalry to Largs. The band of limestone forms a subsidiary bed (probably the lowest) in the Howrat Limestone (=the Hurlet or Main Limestone), the lowest bed of the Lower Carboniferous Limestone group of Scotland. It may be 12 feet or so in thickness, and is very hard and compact where solid and unweathered. The bed is highly charged with siliceous matter, as a large percentage of the contained fossils have been changed into some form of silica. A bed of *Lithostrotion* is present, every polypite of which is completely silicified. The percentage of silica is so high that the limestone is only wrought for manure by the neighbouring agriculturists.

The fossils are obtained by washing the disintegrated material found on ledges of the quarry-face and in fissures and pockets made by the natural jointing of the rock.

Interest will be added to the matter if the descriptions are prefaced by a brief epitome of the structure of the Gasteropod operculum, and a similar account of the number of genera in which this organ has been found in position in Palæozoic shells, a by no means frequent occurrence.

The operculum of the Gasteropoda consists of a layer more or less composed of horny material, strengthened by the addition of calcareous matter. The inner surface carries a muscular scar; and the point from which the operculum commences is termed the nucleus. It may fit the mouth of the shell with accuracy; or the entrance may be only partially closed by it; and, again, in some genera it is quite wanting. The operculum may be said to be concentric when it increases equally all round and the nucleus is central or subcentral—imbricated or lamellar when growing on one side only and with a marginal nucleus—unguiculate or claw-shaped, with the nucleus apical or in front. The operculum is said to be spiral when it grows only on one edge, revolving as it grows, and is always sinistral in dextral shells; when few-whirled the operculum is said to be paucispiral, or subspiral when the turns are little marked; on the contrary, when the whirls are very numerous it is said to be multispiral. One side has sometimes a projection, in which condition the word "articulated" is used to express the form. The operculum is present in some species of a genus, absent in others; and it is also indifferently horny or shelly (*Woodward*)[*].

The description of opercula in the Gasteropoda of the older rocks has not been of frequent occurrence, although a few instances have been observed both amongst Silurian and Carboniferous representatives of the class.

Amongst Silurian univalves we meet with the peculiar genus *Maclurea*, in which the operculum is thick, solid, and sinistrally subspiral, with two internal projections, one of them beneath the nucleus, very thick and rugose[†]. Mr. Salter has given excellent figures of the operculum of both *M. Logani*, Salter[‡], and *M. Peachii*, Salter[§], from the Durness Limestone of the northern Highlands.

In addition to those of *Maclurea*, the operculum of *Euomphalus* has been noticed by the late Dr. S. P. Woodward[||], who describes it as shelly, round, and multispiral.

Mr. F. Smithe, LL.D.[¶], has described and figured the operculum of *Euomphalus sculptus*, Sow. He states that it is shelly, ovate, concave within, plane without, thin, and with a bevelled edge. The spiral consists of twelve whirls.

Passing to rocks of the Carboniferous period, we find that the operculum has been observed chiefly in the genus *Nati-*

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[*] Man. Mollusca, pp. 101, 102.

[†] *Ibid.* p. 202.

[‡] Murchison's 'Siluria,' 4th ed. p. 197, foss. 40. fig. 1 *a*; and dec. i. Geol. Survey Canada, t. i.

[§] Quart. Journ. Geol. Soc. xv. p. 378, t. 13. figs. 1 *b*, 3-5.

[||] Man. Moll. p. 145.

[¶] Proc. Cotteswold Nat. Field-Club.

copsis. In 1844 Prof. M'Coy noticed that of *N. Phillipsii* (M'Coy)[*], and figured this structure entirely filling-in the mouth of the shell[†]. Later on the same author stated that the operculum of *Naticopsis* differed from that of any of the Naticidæ in being concentric and not spiral[‡]. The most complete description of the operculum of *Naticopsis* yet given is that by Messrs. Meek and Worthen. These authors describe it as thick and shelly, oval or subcircular in form, with a lateral or submarginal nucleus, with an entire absence of a spiral or subspiral structure, and no articulating projection. The inner side presents a distinct reniform scar of attachment, whilst the fine and concentric lines of growth are visible on the outside[§].

Finally, in the British Museum is a fine example of *Naticopsis Phillipsii*, M'Coy (?=*N. elliptica*, Phill.), with the operculum *in situ*, which will be described hereafter; it is the shell referred to by Prof. M'Coy[‖].

1. Carboniferous Forms.

It is quite open to argument whether some of these bodies may not be the otoliths of fishes. Bearing this in mind, I consulted my colleague, Mr. W. Davies, F.G.S., who was kind enough to examine the specimens with me. The result of the inquiry was that, although some bore a striking resemblance to otoliths, others, on the contrary, appeared to afford evidence of the operculum view. The question even presented itself as to how large a proportion of the bodies found in rocks of a younger age than the Carboniferous, and usually regarded as otoliths, may be the opercula of Gasteropoda of those beds.

The first form is more or less circular in outline, rounded and thin-edged on one margin, thickened on the other, and produced into a blunted denticulation or two. The centre of one side is somewhat raised above the sharp margin, leaving a flattened zone, and sometimes traversed by a groove or two. This is a common type, and is frequently much worn, when the characters become obliterated. The opposite side is smooth and convex. Lower Carboniferous Limestone group, Law Quarry, near Dalry (Pl. II. fig. 1).

The second variety is small and oval, with a central rounded nucleus, and a notch in the margin opposite, to which the nucleus is nearest. The reverse side of the operculum is plain except for a slight convexity in the centre. As before, Law Quarry (Pl. II. fig. 2).

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[*] Synop. Carb. Limest. Foss. Ireland, 1844, p. 33.

[†] *Ibid.* t. 3. fig. 9.

[‡] Brit. Pal. Foss. 1853, fasc. iii. p. 543.

[§] Illinois Geol. Survey Report, iii. p. 365.

[‖] Brit. Pal. Foss. p. 543.

Another condition consists of elongated pinna-shaped bodies, flat or very slightly concave on one surface, and without visible marks or ornament. The other aspect is convex, particularly on one side, where it is thickened and gradually thins away to the edge. One end is rounded, the other bluntly pointed. As before, Law Quarry (Pl. II. fig. 3).

The fourth type consists of thin auriform bodies, a little thicker on one of the longer margins than on the other, concave on one side, more or less flattened on the opposite. The latter carries a minute central depression or umbilical spot, round which the surface is concentrically striated, and a direct groove passing to the acuminated end. On the concave side of these opercula there is a scar which may be generally described as horsehoof-shaped, and a groove bounding the raised portion. As before, Law Quarry, and on a similar horizon at Inverteil Quarry near Kirkcaldy (Pl. II. fig. 4).

The fifth and last form is that of a small, thin, round operculum, concave on one side, more or less convex on the other. The concave side shows a doubly impressed scar, having the appearance of a dumb-bell. As before, Law Quarry (Pl. II. fig. 5).

The deposit yielding the opercula occasionally furnishes examples of Gasteropoda with them *in situ*. I give two illustrations of this, one with the operculum entire, the other with it only partially preserved. In both cases the opercula fit the mouths of the shells completely. In the former of these there is a central depression, and the thickened side of the operculum is placed against the pillar-lip of the shell, the sharp edge being outward, resting against the outer lip. There are faint signs of concentric striæ; and the centre is depressed. In all probability these are minute species of *Naticopsis* (Pl. II. figs. 6 & 7).

The sum of the information deducible from the study of these little objects appears to be, that, in the first place, certain Carboniferous Gasteropods possessed thick bony opercula, of a more or less oval form, speaking generally, and of variable size.

In the second place, on the contrary, others were provided with thin, round, or irregularly oval doors to their apertures, and when any structure is visible it appears to be concentric.

Again, a form of an entirely different shape is foreshadowed by the elongated variety described as the preceding third type.

We do not possess as yet any evidence to show the presence in our Carboniferous rocks of the *imbricated*, *unguiculate*, *paucispiral*, *multispiral*, and other forms into which the opercula of Gasteropoda have been grouped.

In our Silurian rocks, on the other hand, we have the spiral operculum in *Euomphalus*.

The *Naticopsis* in the British-Museum collection is unfortunately, except in the region of the mouth, imperfect. In all probability it is *N. Phillipsii*, M'Coy. The operculum is oval, somewhat pointed in its upper part, and concave externally, the most depressed point answering to the internal muscular scar. It bears the closest resemblance to those opercula *in situ* from Law Quarry described in a preceding paragraph. The concentric striæ are very close and regular. It fits the aperture of the shell exactly, and is more or less thickened where it abuts against the pillar-lip (Pl. II. fig. 8).

2. SILURIAN FORMS.

The British-Museum collection contains two peculiar bodies from the Upper Silurian beds of the island of Gothland, stated on the labels forwarded with the specimens to be the opercula of *Euomphalus* (Pl. II. fig. 9). They are bluntly conical in form, rising from a flattened or somewhat concave base. The smaller is 3½ lines high, by nearly 6 wide; the larger one is 7 lines in height, by a little more than 6 lines in diameter. Both are marked by close-set concentric raised lines of laminæ, subimbricating upwards. About half the distance from the base to the blunt apex the sides are somewhat constricted, and the upper part is thus partially separated from the lower. The flatly concave base is bounded by a marginal rim, and the centre is occupied by a somewhat sunken coiled nucleus. These bodies have a very peculiar appearance, and, if really opercula, must have belonged to a strong massive shell. The upper third or apical portion appears to be devoid of concentric lines or ridges.

The collection is also enriched by several specimens of a *Euomphalus* with the operculum in place, from the Wenlock Limestone, and by an operculum lying on the weathered surface of the limestone, separated from the shell. The opercula of these shells correspond generally with the description given by Mr. Smithe, but differ in one or two minor particulars.

The marginal outline is quite circular or round; but as the centre is approached the spiral rings become decidedly oval (Pl. II. fig. 13). The number of these rings in the best-preserved of our specimens is seventeen, and there were evidently a few more. There is, however, no trace of a nodose or bead-like character, so far as my examination of these specimens has gone. The rings are concentric and ridge-like, each separate from the other, with well-marked interspaces between them, the interspaces being quite double the width of the ridges, if not a little more (Pl. II. fig. 13).

Three of the British-Museum specimens with the operculum in place have the latter presented with the spiral whirls outwards; and this surface is decidedly (although not very) concave (Pl. II. figs. 10 & 11).

This is shown in a somewhat exaggerated form in the free example, but heightened by fracture and compression from above. On the other hand, in a fourth example, also with the spiral side of the operculum exposed in place, the latter is quite depressed conical (Pl. II. fig. 12).

Lastly, in a fifth specimen the circular form of the operculum is well exhibited, and a somewhat different appearance visible (Pl. II. fig. 14). The operculum is depressed a little immediately within the margin, and then rises at the centre into a low spiral prominence. The surface is shining and smooth, except near the margin, where there are a few very fine spiral thread-like lines. This aspect is rather difficult of explanation; but I believe it to represent either the interior of the plate or a cast of the interior, and to be reversed in position.

The five specimens here noticed are what is usually called *Euomphalus sculptus*, J. de C. Sow.*, which was briefly described as having the "surface ornamented with concentric furrows and elevated lines." This description must have been taken from a very much worn example; for even in indifferent specimens the close, transverse, undulating frills of growth which cross these "elevated lines" are quite visible.

The characters of a well-preserved example of *E. sculptus* are quite those assigned to another species, *E. funatus*, J. de C. Sow.†, viz., "Conical, very short; ornamented with many spiral threads, united by more numerous transverse lines; umbilicus rather small."

It will be noticed that no mention is made of the number of concentric ridges, or any approach thereto, in the respective species. On comparing the figures, however, it will be seen that those on the body-whorl of *E. funatus* are much wider apart and less numerous than those on a corresponding portion of the shell of *E. sculptus*.

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* Murchison's 'Silurian System,' p. 626, t. 12. f. 17.

† Min. Conch. 1824, v. p. 71, t. 450. f. 1 & 2; 'Silurian System,' p. 626, t. 12. f. 20.

Without asserting the identity of these two forms, it becomes necessary to point out the very close relation existing between them; and it may be that they are only the old and young conditions of one species. The concentric ridges on the body-whorl of *E. sculptus* become wider apart as the suture is approached, when they often assume very much the appearance given in the figures of *E. funatus* referred to. The apparent similarity between these shells should be indicated, in case any difference may be detected in their opercula. That of *E. funatus* has not been described, so far as I know.

EXPLANATION OF PLATE II.

Fig. 1. A small circular operculum (?) produced into a blunted denticulation. Law Quarry.

Fig. 2. A small oval operculum, with a central globular nucleus. Law Quarry.

Fig. 3. An elongated pinna-shaped body, probably an operculum. Law Quarry.

Fig. 4. A thin, somewhat auriform body of the same nature. Inverteil Quarry, near Kirkcaldy, Fife.

Fig. 5. A small, thin, round operculum. Law Quarry.

Figs. 6 & 7. Two small shells, probably species of *Naticopsis*, with the opercula *in situ*. Law Quarry.

Fig. 8. *Naticopsis Phillipsii*, M'Coy, with the operculum in place, but partially abraded on one side. Collection, British Museum.

Fig. 9. A supposed operculum, conical and with imbricating ridges. Upper Silurian, island of Gothland. Collection, British Museum. × 2.

Figs. 10 & 11. *Euomphalus sculptus*, Sow., with the operculum in place. Wenlock Limestone. Collection, British Museum.

Fig. 12. Another specimen, but with the outer side of the operculum somewhat conical. Collection, British Museum.

Fig. 13. The operculum of *E. sculptus* free. Collection, British Museum.

Fig. 14. *Euomphalus sculptus*? with a shining scarcely spiral operculum. Collection, British Museum.

(N.B. The originals of figs. 1–7 are in the cabinet of Mr. James Bennie.)

V.—*Descriptions of new Species of Lepidoptera in the Collection of the British Museum.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Plate IV.]

The species described in the present paper are chiefly from India and China, all, with one exception, being Asiatic, and the latter being the first African species in a hitherto purely Asiatic genus.

Nymphalidæ.

1. *Argynnis gemmata*, sp. n. (Pl. IV. fig. 1.)

Fulvous, with the body and basal third of the wings shining coppery brown: wings with three transverse series of black spots, the first biangulated, in zigzag fashion, on the primaries, and simply angulated on the secondaries; this series is placed just beyond the middle of the wings; the second and third series united at their costal extremities near the apex; a nearly marginal interrupted black line: primaries with thick black discoidal markings, much as in *A. cashmirensis*; a subcostal, ill-defined, blackish, triangular spot between the first and second series. Primaries below paler than above, with smaller black spots, the basal area not brown, as above, but uniform with the rest of the ground-colour, the costa ochreous towards apex, and the outer margin and fringe spotted with the same colour; an oblique apical chestnut-red stripe, margined internally by a conspicuous spot and a minute dot of silver, and bounded externally by an abbreviated submarginal series of six oval silver spots, which decrease in size at both extremities of the series; the first two visible spots of the second series of the upper surface greyish green: secondaries somewhat like those of *A. myrina* (but altogether brighter and prettier, with the central silver spot more as in *A. lathonia*), bright ferruginous varied with patches of ochreous, the basal half occupied by about fifteen silver spots and streaks of various sizes and shapes, the two central ones united and passing through a postmedian arched series of sagittate silver spots; a marginal series of large triangular spots, abdominal margin, and the base of the costal margin silver; all these markings are slenderly edged with black; a discal series of dull green rounded spots with silver pupils; fringe bright ochreous spotted with ferruginous: body below ochraceous. Expanse of wings 1 inch 11 lines.

Darjiling (*Lidderdale*); between Nepal and Tibet (*Charlton*).

The two examples taken by Major Charlton have been in the Museum collection since 1852; but, probably owing to the fact that they belong to a difficult genus, nobody appears to have ventured to describe them. I find them labelled "Tibet;" but our register says "between Nepal and Tibet," and the fact that Dr. Lidderdale labels his specimen as taken at "Darjiling" renders it extremely likely that Major Charlton's were also taken on the Nepal side of the Himalayas.

The position of this species seems to be next to *A. myrina*.

Papilionidæ.

2. *Papilio nebulosus*, sp. n. (Pl. IV. fig. 3.)

In some respects nearest to *P. antiphates*, in others to *P. euphrates*, but the primaries dull greyish black, crossed at the base by two broad pale belts; the costal half of the wing also crossed by four abbreviated white bands, united below the median vein so as to form two large U-shaped markings, and crossed by black veins; submarginal tapering band as in *P. euphrates*, white; a large roundish diffused patch of white on the internal area near the exterior angle: secondaries as in *P. antiphates*, excepting that they appear greyish through their showing the markings of the under surface, and that the submarginal lituræ are continued upwards above the third median branch. Wings below blackish; the base and the interno-median area of the secondaries sordid white or brown, shading into white; subbasal band of primaries scarcely traceable; other markings as above, but sordid: secondaries with the abdominal margin and fringe white, bounded internally by a black stripe along the submedian vein; a central elbowed series of six sordid-white elongated spots, bounded on both sides by ill-defined black spots, the third or central spot pyriform and enclosing a smaller black spot; a discal angulated series of six more or less pentagonal ochreous patches, their two outer sides slightly sinuated and black-edged; a submarginal series of five almost confluent, oblong, sordid-white patches placed corner to corner; outer margin and tail black: body below white, spotted at the sides with black; anus pale flesh-coloured. Expanse of wings 3 inches 3 lines.

Darjiling (*Lidderdale*).

But for the fact that this species is, in some of its most important characters, nearer to *P. euphrates* of the Philippines, I should have thought it possible that it might be an extraordinary melanistic variety of *P. antiphates*.

3. *Papilio Mariesii*, sp. n. (Pl. IV. fig. 4.)

Allied to *P. alebion*, from which it differs in the absence of the submarginal black band on the primaries, the narrower discal belt of secondaries, which is greyish externally and becomes obsolete towards the costa, the slightly larger white spots above the blue-centred marginal black spots of the secondaries, and the slightly larger and deeper-coloured orange subanal patch: on the under surface the primaries differ as above, the outer discal line of the secondaries is obsolete, and the marginal black stripe encloses a much smaller spot of the ground-colour at apex. Expanse of wings 2 inches 10 lines.

Lu Shan mountains, province of Kiukiang, China.

One specimen of this species was taken by Mr. Charles Maries.

4. *Thecla betuloides* (Blanchard in litt.). (Pl. IV. fig. 2.)

Above chocolate-brown, shot with purple, excepting on the outer border: primaries with a large patch of bright orange on the disk immediately beyond the cell: secondaries with an orange patch at the anal angle. Under surface grey; the cells closed by a short brownish fasciole with darker marginal lines edged externally with white; an oblique discal band and a second band nearer and parallel to the outer margin of the same colours; a submarginal dusky stripe, followed in the secondaries by a white marginal line; base of fringe occupied by a black line: secondaries with an orange anal patch enclosing a black dot on the first median interspace; a subanal W-shaped blackish line joining the inferior extremity of the inner discal band, its inner edge bordered with orange and its outer edge with white; anal lobe and tail black; pectus white, venter testaceous. Expanse of wings 1 inch 4–6 lines.

Three specimens. Kiukiang, China (*Maries*).

Although quoted in the Supplement to Mr. Kirby's 'Catalogue,' this species cannot be regarded as described by Blanchard; that author simply remarks, "In the neighbourhood of Pekin an allied species exists which is distinguished by several characters;" and in a footnote he says "This species (*Thecla betuloides*, Lucas) has the wings tinted with blue above and grey below." From the vague resemblance which the species bears to *T. betulæ*, and from the fact that the underside is grey and the upperside shot with purple (not blue), I have little doubt that the species here described is that mentioned by Blanchard; and therefore I have adopted for it the name which he has proposed; but nobody can be *certain* of any thing from his casual hints as to the insect.

5. *Thecla tyrianthina*, sp. n. (Pl. IV. fig. 5.)

Above brown, shot with purplish blue in the male and with purple in the female. Under surface of wings pale greyish brown, darker towards the base; a brown fasciole, traversed by a pale line, at the end of the cell; a broad, slightly tapering discal brown belt from the costal margin of each wing; a submarginal brown stripe and a marginal brown border: secondaries with an orange patch enclosing a square of four black spots, bounded above by an incomplete W-shaped black line, and below by an alternately white and black fringe; a black-edged whitish oblique band near the anal angle across the abdominal border, bounded internally by a brown band, and externally by an orange marginal border; anal lobe and tail black tipped with white: pectus greyish, palpi white below, venter testaceous. Expanse of wings 1 inch 3-4 lines.

Kiukiang, China (*Maries*).

Allied to *T. arata.*

6. *Thecla stygiana*, sp. n. (Pl. IV. fig. 6.)

Above smoky brown, without markings. Wings below greyish brown, with an indistinct externo-discal series of blackish spots bounded outwardly with yellowish: primaries with an indistinctly whitish-bordered black spot at external angle: secondaries with a very indistinct submarginal series of dusky spots; a patch of orange at external angle enclosing a black spot above the tail, which is also black; anal angle black: pectus bluish white; venter sulphur-yellow. Expanse of wings 1 inch 7 lines.

Nikko, Central Japan (*Maries*).

7. *Milleria pontioides*, sp. n.

Creamy white: primaries with the veins brown; external two fifths brown, enclosing a small white spot at the inferior angle of the cell, and crossed by a disco-submarginal series of abbreviated whitish dashes upon the veins: secondaries with the outer half greyish; a broad external brown border from costa to first median branch, interrupted by five longitudinal whitish dashes on the veins: antennæ black. Primaries below nearly as above, but the external area blackish, and the spots upon it white: secondaries sulphur-yellow, excepting towards the costa, the outer half black-brown, with the end of the cell and five streaks on the veins white. Expanse of wings 1 inch 9 lines.

Sarawak (*Low*).

Somewhat like *Pontia pactolica*, Butl., in pattern and coloration.

Lithosiidæ.

8. *Camptoloma binotatum*, sp. n.

Nearly allied to *C. interioratum* (*C. erythropygum*, Felder, Nov. tab. xciii. fig. 7) from China and Japan, but with the primaries ochreous, nearly as dark as the secondaries; the oblique lines from near the base of the costal margin not united to one another, consequent upon the abbreviation of the inferior or basal one; the upper line, on the contrary, continued (by means of a terminal elbow) through the red streaks, and uniting with the oblique line immediately beyond the cell; the fourth or subapical discal line longer, slightly waved or bisinuated instead of regularly concave; the submarginal line longer and much more slender; only two instead of three large black spots on the fringe at external angle. Body bright ochreous, the thorax scarcely perceptibly paler than the abdomen; anus lake-red. Expanse of wings 1 inch 7 lines.

Two specimens. Shillong (Assam).

I have examined a fair series of the Japanese species, and therefore am in a position to state positively that it is not a variable insect.

Liparidæ.

TRISULOIDES, gen. nov.

Trisulæ affine genus; differt alis anticis minus productis; posticis magis rotundatis; capite retracto, breviore; palpis brevioribus; signaturis supra generis *Chrysorithri* vel *Catocalæ*.

9. *Trisuloides sericea*, sp. n.

Smoky brown; sericeous, especially the primaries; these wings above transversely irregularly banded with sandy brown, the bands being bordered and intersected by blackish lines; a more or less defined, nearly semicircular, pale patch from the costa to the first median branch and slightly impinging upon the discoidal cell; outer border sandy brown, very irregular along its inner margin, which is edged with black; its outer margin is pale, limited by a submarginal series of dusky spots; a double black spot, bordered internally with snow-white, just touching the external border near the external angle; fringe whity brown, spotted with blackish: secondaries pale towards the costa; a large central ochreous patch; a squamose marginal streak near the anal angle; fringe white or whitish varied with quadrate black spots: head, front of thorax, and posterior margins of the abdominal segments greyish; abdomen with four dorsal tufts. Wings below sericeous, pale, the outer borders dull silvery white; veins blackish; a nearly central, angulated, dusky band, followed by a testaceous band bounded externally by an angular dusky line, immediately beyond which is a curved externally dentated dusky stripe; marginal line blackish; fringe white, spotted with black: primaries with ochreous basal area: body below blackish, pectus more or less clothed with greyish hairs; tarsi more or less distinctly banded with grey. Expanse of wings 2 inches 6 lines.

Shillong, Assam, and Darjiling.

On the upper surface this species much resembles *Chrysorithrum*, *Allotria*, and *Catocala*, the primaries especially reminding one of Walker's "*Catocala*" *albifascia*, a species apparently referable to the genus *Zalissa*; in structure and the pattern of the under surface it agrees far better with *Trisula*.

Acontiidæ.

10. *Apsarasa liturata*, sp. n.

Primaries above sulphur-yellow, costal margin white; all the borders crossed by black-edged metallic blue-green lituræ as follows—two near the base of the costal border, two at basal fourth, one running obliquely from just before the middle of the costa to the end of the cell, where it unites with an irregularly ω-shaped line of the same colour interrupted by a shining rose-red discoidal dash, three curved lines on the costal border beyond the cell, the first very short, a dot followed by a zigzag line just before apex, and an oblique V-shaped marking at apex; markings of the outer border becoming brown upon the fringe, the first and third being short dashes, the second formed of two dashes united by a <-shaped marking, the fourth and fifth long dashes, nearly united internally by a metallic green lunule; on the internal border two <-shaped markings before the middle, an oblique line beyond the middle, and three reversed oblique lines close to external angle; at the base of the median area is a large 3-shaped marking, partly metallic green and partly rose-red, and on the second median interspace two rose-red transverse spots, dotted at each end with metallic blue-black: secondaries semitransparent sericeous white, with sulphur-yellow borders and veins: head, collar, front of thorax and of tegulæ sulphur-yellow, transversely striped and spotted with bluish and purplish black, remainder of body white. Under surface cream-colour, sericeous. Expanse of wings 1 inch 7 lines.

♂, Camaroons; ♀, Old Calabar.

Evidently congeneric with *A. radiata* and *A. figurata*, but more beautiful in colouring.

VI.—*New Neotropical Curculionidæ.*—Part IV.

By Francis P. Pascoe, F.L.S. &c.

BRACHYDERINÆ.

Pandeletius naupactoides.
Phanasora, n. g.
—— plumbea.
Naupactus simplex.
—— chloropleurus.
—— serenus.
—— imbutus.
—— sulphurifer.
—— magicus.
Megalostylus expansus.
Emmeria, n. g.
—— marginata.

OTIORHYNCHINÆ.

Exorides, n. g.
—— carinatus.

CHOLINÆ.

Cholus luctuosus.
—— mœstus.

Pandeletius naupactoides.

P. ovatus, fulvus, squamulis subsilaceis tectus; capite, prothorace femoribusque anticis fuscis, squamulis viridibus sparse adspersis. Long. 2½ lin.

Hab. Brazil.

Ovate, fulvous, covered with small whitish-yellow scales; head, prothorax, and anterior femora brown, with scattered greenish scales, but denser and brighter on the latter; rostrum rather longer than broad, slightly sulcate at the base, the lower half covered with bright green scales; antennæ testaceous, scape not extending beyond the middle of the eye; funicle with the first joint stout, much longer than the second, the rest transverse, club short; prothorax well rounded at the sides, coarsely granulate-punctate, an impressed line in the middle; scutellum punctiform; elytra rounded at the shoulders, coarsely punctate-striate; body beneath covered with bright green scales, except the last two segments of the abdomen; fore legs much longer than the others, their femora very stout, their tibiæ denticulate on the inner margin, all, except the anterior femora, testaceous.

In the rounded sides of the prothorax this species agrees with the North-American *P. hilaris* (Hbst.), but differs in coloration, in the relative size of the basal joints of the funicle, and in the larger fore legs.

PHANASORA.

Rostrum subangustum, sulco angulato basi a capite separatum. *Antennæ* mediocres, subterminales; *scapus* oculum superans; *funiculus* articulis duobus basalibus longitudine æqualibus. *Prothorax* subcylindricus. *Elytra* basi prothorace latiora. *Pedes* subæquales; *femora* clavata, omnia infra dente acuto armata;

tibiæ intus bisinuatæ, apice mucronatæ; *corbulis* apertis; *tarsi* articulo ultimo ampliato; *ungues* liberi. *Abdomen* normale.

One of my specimens has the MS. name of *Pandeletius cæruleus*, Buq., attached to it; but from *Pandeletius* and allied genera it differs in the angular groove at the base of the rostrum, and in all the femora being toothed beneath.

Phanasora plumbea.

P. ovata, squamulis cæruleis approximatis tecta; tibiis anticis intus denticulatis. Long. 2¼ lin.

Hab. Bogota.

Ovate, black, covered by approximate pale blue scales (hence the colour as a whole appears to be dull leaden); rostrum longer than the head, flattened above, and rather sharply angled on each side; antennæ black, last five joints of the funicle somewhat turbinate; eyes lateral, rounded; prothorax slightly rounded at the sides, granulate above, the base truncate; scutellum punctiform; elytra moderately convex, nearly twice as broad as the prothorax at the base, punctate-striate, punctures approximate; teeth of the femora slender, curved.

Naupactus simplex.

N. obovatus, brunneus, squamulis pallidioribus subapproximatis tectus; rostro antice excavato; antennis elongatis; tibiis anticis intus denticulatis. Long. 3¼ lin.

Hab. Brazil.

Obovate, everywhere reddish brown, covered with small paler subapproximate scales; rostrum broadly excavated between the insertions of the antennæ, the median impressed line or canal extending to the back of the head; eyes prominent; antennæ ferruginous, slender, elongate; scape extending to behind the eye; second joint of the funicle nearly twice as long as the first; prothorax above equal in length and breadth; scutellum triangular; elytra convex, seriate-punctate, punctures distinct, subapproximate; intercoxal process broad, subtruncate.

Allied to *N. durius* (*Sitona durius*, Germ.), but with a much longer prothorax and a less delicate punctuation of the elytra.

Naupactus chloropleurus.

N. niger, indumento brunneo tenuiter vestitus, lateribus læte argenteo-viridibus, supra setulis minutis adspersus; rostrum curvatum, postice capiteque profunde sulcatis. Long. 6 lin.

Hab. Bahia.

Black, loosely covered with a light-brown indumentum, the sides of the prothorax and elytra covered with bright silvery green overlapping scales, and everywhere, especially the legs, furnished with very minute scattered setulæ; rostrum curved, a deep groove from the middle to between the eyes; antennæ slender; scape passing behind the eye; funicle elongate, second joint more than twice the length of the first, the fourth shorter than the third or fifth; club elliptic; prothorax transverse, rounded at the sides, subgranulate; scutellum cordate; elytra seriate-punctate, each rounded at the apex, green stripe broad, irregularly indented, at one point behind the middle continued to the outer margin; body beneath with silvery green scales on each side and on the coxæ.

In coloration this species resembles to a certain extent *N. stauropterus* (*Leptocerus stauropterus*, Germ.); but, *inter alia*, the stripe on the elytra is continuous, not interrupted so as to give the black central portion the figure of a cross as in the latter.

Naupactus serenus.

N. niger, squamulis cupreis dense tectus, elytris singulatim vittis duabus metallice viridibus ornatis. Long. 6 lin.

Hab. Parana.

Oblong-obovate, black, covered with cupreous scales, each elytron with narrow metallic green stripes; rostrum slightly concave above; antennæ ferruginous; scape scarcely extending behind the eye; funicle with all the joints elongate, the second three times as long as the first; club slender, not longer than the two preceding joints together; prothorax transverse, rounded at the sides, not canaliculate; scutellum round, covered with golden-green scales; elytra moderately convex, obliquely truncate at the shoulders, the apex narrowly rounded, irregularly seriate-punctate, the punctures minute, outer green stripe nearly the length of the elytron, the inner shorter; body beneath covered with silvery green scales; fore legs moderately robust.

This species appears to have *N. decorus* (Fab.) for its nearest ally; but the latter has a rugose prothorax and is differently coloured.

The males in this genus have the elytra much narrower than the females, and the prothorax often considerably larger or even globose.

Naupactus imbutus.

N. nitide fuscus, squamulis minutis sparse indutus; elytris vittis duabus interruptis marginibusque flavidis. Long. 8 lin.

Hab. Macas.

Glossy brown, sparingly furnished with minute scales, each elytron with a reddish-yellow or luteous stripe interrupted in the middle, the side broadly margined with the like colour; rostrum slightly angular on each side, the central canal not extending beyond the middle; antennæ piceous, slender; funicle with all the joints very long, the second three times as long as the first; club not so long as the two preceding together; eyes very prominent; prothorax very transverse, finely punctured, canaliculate; scutellum triangular; elytra convex, shoulders somewhat angular, the apex produced and narrowly rounded, scutellar border elevated, striate-punctate, punctures transverse, interstices narrow; body beneath pitchy brown; fore legs robust, their coxæ not contiguous.

This species belongs to Schönherr's first Stirps; but I have not seen any thing which can be called an ally.

Naupactus sulphurifer.

N. fuscus, indumento griseo sparse leviter indutus, lateribus prothoraceque vittis duabus, basi fascia transversa connexis, læte sulphureis. Long. 6½–7 lin.

Hab. Uruguay.

Brown, inclining to pitchy, with a thin greyish indumentum and a few black setæ; the sides of the prothorax and elytra, the anterior margin of the former, and a stripe on each of the latter (connected by a cross band at the base with its fellow) a rich sulphur-yellow; rostrum rather narrow, concave above; antennæ slender, second joint of the funicle twice as long as the first, the third shorter than the fourth, the seventh as broad at the apex as the club, the latter slender, acuminate; prothorax transverse, the sides rounded, finely granulate above; scutellum scutiform; elytra (♂) scarcely broader than the prothorax at the base, narrowly rounded at the apex, irregularly and finely punctate-striate; body beneath with a sulphur-yellow pubescence; legs ferruginous, the anterior robust, with their tibiæ and tarsi pitchy.

The sulphur markings are composed of a compact mass of indumentum mixed with hairs. I believe this species is *N. bivittatus* of Dejean's Catalogue.

Naupactus magicus.

N. niger nitidus, squamulis isabellinis in vittas longitudinales digestis; antennis brevibus. Long. 6 lin.

Hab. Brazil.

Glossy black with longitudinal stripes of whitish approximate scales; rostrum narrow, deeply concave above;

antennæ short, ferruginous, the funicle scarcely longer than the scape, second joint of the former nearly twice as long as the first; club stout, a pale stripe over the eye continuous with a broader one on the prothorax, the latter slightly transverse, posteriorly a broad groove, which is corrugated on each side; scutellum small; elytra striate-punctate, inflected posteriorly, the outer margin thickened, and towards the apex bluntly denticulate, near the suture a narrow stripe, on the shoulder a double stripe united before the middle and behind the middle interrupted by a round spot; body beneath and legs glossy black, clothed with a few greyish hairs.

An isolated species, somewhat resembling *Hilipus bipunctatus*, Boh., in general appearance.

Megalostylus expansus.

M. oblongus, obscure fuscus, squamulis albis tectus; prothorace transversim triangulari, angulis posticis basin elytrorum superantibus. Long. 4 lin.

Hab. Mexico.

Oblong, dull brown or pitchy, more or less covered with small white approximate scales; rostrum scarcely narrower than the head, concave in front; antennæ stoutish, black; prothorax broadly triangular, the posterior angles acute, extending beyond the elytra at the base; scutellum very small, triangular; elytra moderately convex, gradually rounded from the base to the apex, finely striate-punctate, the punctures almost obsolete; body beneath and legs pitchy brown with scattered white setulæ.

The head is more constricted behind than in *M. rhodopus*, Boh., with which structurally it pretty nearly agrees; but it is at once differentiated by the form of the prothorax.

EMMERIA.

Rostrum breve, robustum, supra canaliculatum, apice triangulariter excisum; *scrobes* curvatæ, infra oculos desinentes. *Antennæ* tenues, breviusculæ, in medio rostri insertæ. *Oculi* suboblongi. *Prothorax* transversus, basi bisinuatus. *Elytra* basi producta, humeris obsoletis. *Pedes* breviusculi; *femora* incrassata, haud petiolata; *tibiæ* anticæ curvatæ, omnes intus denticulatæ; *corbulis* cavernosis; *tarsi* breviusculi, æquales; *ungues* liberi. *Processus* intercoxalis angustus. *Abdomen* segmentis tertio quartoque brevibus.

With the general appearance of *Eustales* this genus has the broad rostrum of *Cyphus*, but without the prominent shoulders of the latter. Lacordaire gives "corbeilles glabres" as one of the characters of *Eustales*; in all that I have examined they are scaly.

Emmeria marginata.

E. subelliptica, squamulis læte argenteis dense tecta, lateribus vitta splendide cærulea ornatis. Long. $4\frac{1}{2}$–5 lin.

Hab. Pará.

Subelliptic, closely covered with rich silvery scales, the sides of the head, prothorax, and elytra with a brilliantly sparkling blue or green stripe (depending partly on the light), the apex of the latter dull brownish or blackish; rostrum slightly narrower than the head, the excised portion ciliated on each side; antennæ pitchy, pubescent, first joint of the funicle shorter than the second, equal in length to the third; club as long as the last four joints together; prothorax equal in length and breadth, slightly rounded at the sides, a lightly impressed median line; scutellum oblong; elytra moderately convex, seriate-punctate, punctures small, apex of each elytron ending in a small mucro; body beneath black, with oblong imbedded bluish or greenish scales; legs ferruginous, with subapproximate whitish and brownish scales.

EXORIDES.

Rostrum breviusculum, canaliculatum, apice excavatum; *scrobes* rectæ, ad oculos desinentes. *Antennæ* graciles, subterminales; *scapus* oculum superans. *Oculi* rotundati. *Prothorax* normalis. *Elytra* connata, basi prothorace haud latiora, ad latera abrupte declivia. *Pedes* mediocres; *femora* integra; *tibiæ* subrectæ, apice mucronatæ; *corbulis* cavernosis; *tarsi* æquales; *ungues* liberi. *Abdomen* segmento primo inter coxas angusto, antice rotundato.

A somewhat anomalous genus. It would seem to be somewhere near *Naupactus*; but the straight scrobes show that its true place is with the Otiorhynchinæ. With its cavernous corbels and free claws it would be referred, according to Lacordaire's arrangement, to his "Celeuthétides." None of the species of that group are American; and, moreover, the broad truncate intercoxal process is a character which this genus does not possess; so that for the present we must consider its affinities doubtful.

Exorides carinatus.

E. ellipticus, niger, squamulis griseis, aliis orchraceis, tectus; prothorace elytrisque carinis duabus instructis, his postice nodosis. Long. 7 lin.

Hab. Macas.

Elliptic, somewhat narrow and compressed, covered above with pale greyish scales alternating above with ochraceous; head and rostrum black, with scattered very minute scales, apex of the latter with a broad deep excavation between the insertions of the antennæ; scrobe expanding in front of the eye, the upper boundary slightly curved; antennæ black, second joint of the funicle longer than the first, the rest gradually shorter, club with a silvery pubescence; prothorax rather broader than long, sides rounded, two curved black carinæ on the disk, the interval concave and canaliculate; scutellum small, triangular; elytra seriate-punctate, a strongly raised carina on the third interstice, terminating in a prominent nodosity, another carina on the seventh interstice, the apex narrow and compressed, ending in two short diverging points; body beneath and legs black, furnished with pale scattered setulæ.

Cholus luctuosus.

C. ovatus, aterrimus, squamulis suberectis concoloribus tectus, fasciis pallide flavis ornatus; corpore infra denso albido-squamoso. Long. 6 lin.

Hab. Sarayacu.

Ovate, intensely black, with small semierect scales of the same colour, and with bands of pale yellowish overlapping scales on the prothorax and elytra; rostrum rather long, dilated and finely punctured at the apex; antennæ pitchy, the two basal joints of the funicle equal in length, club elliptic; prothorax transverse, contracted anteriorly, the apical margin and large spot at the sides pale yellowish; scutellum oblong; elytra scarcely broader than the prothorax at the base, the shoulders nearly obsolete, the apex broadly rounded, entire, a pale yellow basal band not extending beyond the shoulders, another behind the middle, but interrupted at the suture, and a large spot on each side between the two bands pale yellowish; body beneath covered with minute whitish scales; legs with longer hair-like setulæ; anterior coxæ approximate.

This species is not unlike *Amerhinus Bohemanni*, Mann., in coloration; but *Cholus* differs generically in its longer legs. *Polyderces*, Schönh., is another genus with the feeblest of characters, and only adopted by Lacordaire with hesitation as distinct from his *Archarias*, which he separates from *Cholus* by the absence of the serrated apex of the elytra and the truncated (not angulated) intermediate segments of the abdomen; but if united with *Polyderces*, it would lead to such an alteration of nomenclature that I have thought it better to keep them all in *Cholus*, especially as, throughout the whole of the group, structural characters are not correlated with the general appearance.

Cholus mœstus.

C. oblongo-ovatus, depressus, subnitide niger, denudatus, elytris macula basali utrinque fasciaque pone medium, ad suturam interrupta, ex squamulis pallide flavis confertis ornatis. Long. 7 lin.

Hab. Sarayacu.

Oblong-ovate, depressed, black, slightly glossy, glabrous, a spot at the base near the shoulder and a slightly oblique narrow band, not meeting its fellow at the suture, composed of pale yellowish minute scales; rostrum glossy black, elongate, dilated and finely punctured towards the apex; antennæ ferruginous, basal joint of the funicle twice as long as the two next together, the rest cylindrical; prothorax transverse, very minutely punctured, a few small glossy spots dotting the duller black; scutellum suboblong, smooth; elytra slightly broader than the shoulders at the base, abruptly contracted near the apex, seriate-punctate, punctures small, distinct; body beneath and legs with small scattered setulæ and round imbedded scales, the legs ferruginous; femora slender.

A glabrous, depressed, and somewhat isolated species; the elytra abruptly contracted towards the apex cause a gibbosity above the contracted portion, which is very marked, although noticeable in many species.

VII.—*On a small Collection of Crustacea and Pycnogonida from Franz-Josef Land, collected by B. Leigh Smith, Esq.* By EDWARD J. MIERS, F.L.S., F.Z.S., Assistant in the Zoological Department, British Museum.

[Plate VII.]

THE Crustacea which form the subject of the present memoir were all collected by Mr. Leigh Smith in a single locality a little to the south of Franz-Josef Land, in lat. 79° 55′ N., long. about 51° E., during his recent expedition to the Arctic seas in his yacht 'Eira,' and have been generously presented by him, with other animals collected in the same cruise, to the British Museum. Mr. W. Grant, who accompanied him as naturalist, undertook the care and preservation of the specimens.

The collection, although not numerous in species, is of considerable interest, in that it contains two Amphipoda which are apparently new to science, and a Pycnogonid which is not only remarkable on account of its very large size (in which it is only exceeded by the gigantic Antarctic species mentioned by Dr. v. Willemöes-Suhm as having been obtained by the 'Challenger' expedition), but also as constituting the type of an apparently new genus allied to, but distinct from, *Pasithoë* and *Rhopalorhynchus**.

The precise locality is, moreover, one hitherto unexplored by the naturalist.

Dr. Camil Heller, in his account of the Crustacea collected by the late Austrian expedition to the North Pole (Denkschr. der Akad. der Wissensch. Wien, xxxv. p. 25, 1878), enumerates twenty-four species of Crustacea and three of Pycnogonida, most of these, unfortunately, without precise indication of locality; and Mr. W. S. M. D'Urban has recently given an account of the Crustacea with other Invertebrata collected by Mr. W. J. A. Grant in the Barents Sea during two expeditions of the Dutch vessel 'Willem Barents,' in 1878 and 1879. Nineteen Crustacea and five Pycnogonida were obtained in these two expeditions. They were determined by the Rev. A. M. Norman and Prof. J. O. Westwood; and all seem to have been collected in latitudes considerably to the south of Franz-Josef Land. (See Ann. & Mag. Nat. Hist. 1880, vol. vi. p. 262).

DECAPODA.

Crangon (*Cheraphilus*) *boreas* (Phipps).

An adult male, length 3 inches 3 lines.

Hippolyte Phippsi, Kröyer.

Four specimens of the female form (described by Kröyer as *H. turgida*) are in the collection; length of the largest 1 inch 8 lines. There is also a specimen which is probably to be referred to the male form of this species, in which all the dorsal teeth of the rostrum except the three nearest to the apical spine are obsolete. There are three teeth on the lower margin. The second supraocular spine is distinctly developed. Length about 1 inch 5 lines.

Hippolyte polaris (Sabine).

Six females are in the collection. The length of the largest is not less than 2 inches 5 lines. The rostrum in this series is $\frac{4-6}{2-3}$-toothed. With these specimens is one that is very probably to be referred to the male or *borealis* form of *H. polaris*, in which the rostrum is entirely devoid of teeth on its upper margin, and possesses but a single small tooth on the lower margin. The larger flagellum of the antennules is considerably thickened. The anterior margin of the carapace is armed with a supraocular and infraocular spine. Prof. S. I. Smith, it may be observed, has noted that in extreme varieties of *H. polaris* the rostrum is wholly edentulous.

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* I regret to have been unable to consult an important memoir by Prof. G. O. Sars, on the new Crustacea and Pycnogonida collected during the Norwegian Expedition in 1877–78, and published at Christiania during the present year (1880).

AMPHIPODA.

Anonyx nugax (Phipps).

Numerous specimens of this, perhaps the commonest Arctic Amphipod, were collected.

Acanthonotozoma inflatum (Kröyer).

A single female was obtained. This specimen agrees very well with Goës's figure of the species; but the anterior margin of the coxa of the fourth thoracic limb is regularly rounded, whereas in Goës's figure it is represented as somewhat angulated. The dorsal carina, which is described by Boeck as very high (*altissima*), on the first three postabdominal segments, in Goës's figure and in our specimen is distinct, but not much elevated.

Acanthostepheia pulchra, sp. n.

(Pl. VII. figs. 1, 2.)

Body robust. Head, as in *A. Malmgreni*, armed with a long dorsally, inferiorly, and laterally carinated rostrum, which is somewhat curved downward toward the apex, and is prolonged beyond the distal end of the first exposed joint of the superior antennæ; posteriorly the dorsal keel of the rostrum is prolonged backward between the eyes to the posterior margin of the head. Each of the segments of the body present, indications of a median dorsal carina, which is elevated in the form of a single obtuse somewhat triangular lobe on the fifth and sixth segments, and forms two lobes on the seventh segment; two similar lobes exist on each of the first four segments of the postabdomen; but the lobes, although acute, are not so greatly produced backward, and on the fourth segment a much greater interval exists between the first and second of the dorsal lobes in *A. pulchra* than in *A. Malmgreni*. The postero-lateral angles of the sixth and seventh segments of the body and of the first three segments of the postabdomen are regularly rounded—not, as in *A. Malmgreni*, produced into spines. The superior antennæ are relatively shorter than in

A. Malmgreni, the last joint of the peduncle being less developed than in Goës's figure of that species. The penultimate joints or palms of the first and second legs in *A. pulchra* are regularly ovate, without indications of teeth on the inferior margins as in Goës's representation of *A. Malmgreni*. The coxal joints of the legs (particularly of the fourth and sixth pairs) appear to be more developed.* As in *A. Malmgreni*, the seventh thoracic legs are greatly elongated. The uropoda and terminal segment do not present any very marked distinctive characters. Length of the largest specimen to tip of rostrum about 1 inch 5 lines.

Three females were collected.

The absence of spines at the postero-lateral angles of the posterior thoracic and postabdominal segments would sufficiently characterize this species, independently of the other distinctions enumerated in the above diagnosis.

The outer maxillipedes are very similar to those of *A. Malmgreni* as figured by Goës. The outer lamina reaches very nearly to the middle of the dilated antepenultimate joint of the palpus.

Halirages fulvocinctus (Sars).

A good series of specimens (females) are in the collection, which agree very well with Goës's figure of the species, and with the specimens collected by the late British Arctic expedition.

Amathillopsis affinis, sp. n.
(Pl. VII. figs. 3–5.)

The head is produced anteriorly into a short, convex, subacute rostrum, which does not reach nearly to the distal end of the first joint of the superior antennæ, and has a small antero-lateral lobe on each side between the superior and inferior antennæ. As in *Amathillopsis spinigera*, Heller, the dorsal surface of each of the thoracic segments and of the first three postabdominal segments bears a long acute dorsal lobe or spine; and, as in that species, the spines become successively longer, the last excepted, which is very small. As in *A. spinigera*, the lateral margins of the first three postabdominal segments are sinuated and terminate in a spine at their postero-lateral angles. The terminal segment is less dilated at its distal end, which is very slightly emarginate. The superior antennæ terminate in very long and slender flagella, and are nearly twice as long as the inferior antennæ; the terminal joint of the peduncle is relatively shorter than in *A. spinigera*, and the accessory flagellum so minute as to be undistinguishable except under the microscope. The first and second legs (gnathopoda) are slender and feeble, the first rather the smaller; the merus is produced distally beneath the carpus, which is about as long as the palm or propus, and is very narrow at its proximal end; the palm in both is about twice as long as broad, of a more oblong form than in *A. spinigera*, obliquely truncated at its distal end, against which the slender arcuate dactyl impinges. The coxal joints of the legs are not so distinctly emarginate at their distal ends; those of the fourth legs are much more developed than in *A. spinigera*. The legs are very imperfect in the single specimen examined; but the basal (2nd) joints of all the legs are oblong-oval and more dilated than in *A. spinigera* as figured by Heller.

The single specimen (which it was necessary to decapitate to examine the mouth-organs) is a female.

This species is easily distinguished from its congener by the form of the telson, the greater length of the superior antennæ, the form of the first and second legs, the carpi of which are not so produced at their infero-distal angles, the coxal joints of the third and fourth legs, &c.

In the mouth-organs, so far as could be ascertained from the dissection of the unique example, the following differences are observable: the apex and accessory process of the mandible is broader, truncated; the exterior lobe of the outer maxillipede does not reach to the middle of the antepenulmate joint of the palpus. The two forms, however, bear a very close external resemblance to one another, and I cannot regard them as generically distinct; moreover the examination of additional specimens is needed in the case of *A. affinis*.

Eusirus cuspidatus, Kröyer.

Three specimens (females) are in the collection. Length of the largest 1 inch 7 lines.

Tritropis aculeata (Lepechin).

A single female example of this common arctic species occurs in Mr. Grant's collection.

PYCNOGONIDA.

Nymphon hirtum, Fabr.

I refer a single example in the collection to this species. The pubescence covering the body is rather short and dense.

Nymphon gracile, Leach.

Five examples are in the collection which appear to be referable to this species.

ANOMORHYNCHUS, gen. nov.

Body robust, with the segments coalescent and the leg-bearing processes nearly in contact with one another. Rostrum greatly developed, constricted at the proximal end, and hence flask-shaped—that is, provided with a distinct neck. First pair of appendages (antennæ or mandibles) wanting; second pair 9-jointed, with the second and fourth joints elongated; third pair (the so-called ovigerous legs) 10-jointed, the fourth and sixth joints elongated, the tenth joint bearing a small terminal claw. Claws of the legs simple. Abdomen about half as long as the body, very slender, uniarticulate.

This new genus must be placed in the family Pycnogonidæ as characterized by Dr. Semper in his arrangement of the group (Verh. physik.-medicin. Gesellschaft Würzburg, vii. p. 274, 1874); but it is not to be confounded with any of the genera therein enumerated. Structurally it is most nearly allied to the *Rhopalorhynchus Kröyeri* of Wood-Mason (Journ. Asiat. Soc. Bengal, 1873, xlii. pt. 2, p. 172, pl. xiii. figs. 1–5, and Ann. & Mag. Nat. Hist. 1873, ser. 4, xii. p. 342), from the Andamans; but in this genus the neck and distinctly-segmented body are very slender, the leg-bearing processes being separated by wide intervals, and the abdomen is rudimentary.

From *Pasithoë*, Goodsir (*Endeis*, Philippi), with which *Oiceobathes*, Hesse, is perhaps identical, this genus is distinguished by the more numerous articulations of the appendages, the great development and basal constriction of the rostrum, and the simple claws.

Anomorhynchus Smithii, sp. n.
(Pl. VII. figs. 6–8.)

The body and its appendages are robust and apparently naked, but clothed with very minute, stiff, sparse hairs, which render the surface scabrous to the touch. The head is very robust, in the larger specimen nearly once and a half the length of the body with the abdomen; its constricted proximal portion or neck widens somewhat suddenly, and is about one fourth the length of the head, which is nearly cylindrical; the oral aperture large and triangulate. The segments of the body are coalescent, and scarcely any traces of them distinguishable. The abdomen is very slender, much narrower than, and half as long as, the body; the ophthalmic process elevated, conical, and acute. The first and second pairs of appendages are closely approximated; the first pair is articulated with a very short process of the thorax; its basal joint is also very short, the second joint considerably elongated, the third very short, the fourth rather more than half as long as the second; of the remaining joints the sixth is longest, but shorter than the fourth. The second pair of appendages is articulated with a short thoracic process; and its first three joints are short, the fourth and sixth joints greatly elongated, the seventh to tenth short, subequal, and fringed with short spines on their under surfaces. The first three joints of the legs, and the processes of the thorax with which they are articulated, are short, the fourth to sixth joints considerably elongated, the seventh little shorter than the eighth, both together not as long as the sixth, the terminal claw styliform and acute. Total length of the largest example 2 inches 2 lines, of the head and neck rather more than 1 inch 3 lines, of the abdomen nearly 4 lines (⅓ inch); greatest width between tips of legs (when expanded) rather more than 8⅓ inches. Two specimens were collected.

The four terminal joints of the third (ovigerous) pair of appendages are short and capable of being coiled together so as to form a prehensile organ, as observed by Prof. J. Wood-Mason in *Rhopalorhynchus Kröyeri*, a peculiarity observable also in some other Pycnogonida.

I have much pleasure in associating with this fine species the name of its distinguished discoverer, Mr. Leigh Smith.

Besides the above Crustacea, certain species were collected by Mr. Smith in the seas to the north of Spitzbergen, about which no detailed observations need be offered. They are *Hippolyte turgida*, a Schizopodous crustacean in too mutilated condition for determination, *Gammarus locusta*, *Onesimus litoralis*, and *Themisto libellula* (in considerable numbers).

EXPLANATION OF PLATE VII.

Fig. 1. *Acanthostepheia pulchra*, sp. n. (nat. size), lateral view.
Fig. 2. Second leg of the same (magnified).
Fig. 3. Outer maxillipedes of *Amathillopsis affinis*, sp. n. (magnified).
Fig. 4. Second leg of the same, showing the form of the hand (magnified).
Fig. 5. Terminal segment of the same (magnified).
Fig. 6. *Anomorhynchus Smithii*, gen. and sp. n. (slightly reduced).
Fig. 7. Lateral view of the body of *A. Smithii*, showing the form of the oculigerous tubercle and cephalic appendages (nat. size).
Fig. 8. Front view of the rostrum of the same, showing the form of the mouth (nat. size).

VIII.—*Descriptions of new Species of Heteropterous Hemiptera collected in the Hawaiian Islands by the Rev. T. Blackburn.* —No. 3. By F. Buchanan White, M.D., F.L.S.

Scutelleridæ.

28. *Coleotichus Blackburniæ*, n. sp.

C. elongato-obovatus, coccineus, puncturis aureo-viridibus et cyaneis confertim ornatus, marginibus lineaque centrali impunctatis; capite supra levissime, subtus forte convexo, apice obtuse rotundato, lateribus (postico excepto), tylo et linea centrali obtuse elevatis; antennis articulis primo secundoque subæquilongis, tertio, quarto quintoque longioribus et inter se subæquilongis; rostro coxas intermedias attingente; pronoto marginibus lateralibus et ad angulos anticos subdepresso, his subincrassatis rectis, angulis lateralibus prominulis obtusiusculis; scutello abdomine subangustiore, linea centrali subelevata; prosterni lobis prostethioque postico subimpunctatis; ventris segmentis pone spiracula macula distinctius punctata destitutis, angulis apicalibus segmentorum secundi usque sexti distincte dentato-productis; segmento anali maris a basi sensim producto, medio transversim haud profunde depresso, apice subtruncato. Capite confertissime punctato, marginibus (postico inter ocellos excepto), linea centrali, et linea tenuiore utrinque prope basin et cum linea centrali parallela, necnon tylo lævigatis; pronoto intra margines anticum lateralesque subtilius et crebrius, disco rude et irregulariter punctato, marginibus maculis irregularibus prope marginem anticum et linea centrali impunctatis; scutello limbo perangusto et linea centrali lævigatis; elytris inter venas conferte punctatis, area magna triangulari ante membranam lævigata.

♂. Long. 16½, lat. 8 m. m.

Of this fine species (which I have dedicated to Mrs. Blackburn) I am sorry that I cannot give a better description as regards the colour. I have described it as being scarlet on the authority of Mr. Blackburn, who has met with three specimens. The one sent to me is (perhaps from having been in alcohol) ochraceous brown in colour, thickly punctured with golden green and dark blue, and only showing a trace of the red ground-colour on the scutellum. Under these circumstances I have said as little as possible regarding the colour, reserving a description of that till I have seen other specimens. Mr. Blackburn remarks that this is one of the rarest of the Hawaiian Hemiptera, only three specimens having been taken, and these at long intervals. It occurs on flowers near Honolulu.

The occurrence of a species of the genus *Coleotichus* in the Hawaiian Islands is rather interesting, as the genus has hitherto been confined to Australia or its more immediate vicinity. Of the five species previously described, two belong to Australia, one to New Caledonia and Woodlark, one to the Fiji Islands, and one to Amboina and Ceram. The Hawaiian Islands seem to have derived the progenitors of their Hemipterous fauna from all quarters; but our knowledge is yet too incomplete to allow of any speculation as to the direction whence the immigration has been strongest.

This species is intermediate between the sections "*a*" and "*a a*" (having some of the characters of both), into which Stål divided the genus in the 'Enumeratio.'

Lygæidæ.

29. *Nysius Blackburni*, n. sp.

N. oblongo-obovatus, niger, subnitidus, capite maculis oblongis magnis 3 inter oculos, tylo linea longitudinali, pronoto macula parva ad marginem anticum et disco postico pro magna parte, clavo maculis parvis, corio maculis majusculis præcipue prope marginem costalem sitis, necnon femoribus apicibus plus minus rufo-testaceis, membrana albida fusco-maculata. Capite pilosulo subtiliter punctulato; antennis rostro brevioribus, articulo secundo quam tertius multo longiore; rostro coxas posticas attingente, articulo primo bucculis subæquilongo; gula basin capitis subattingente; bucculis gula paullo brevioribus, subparallelis, retrorsum sensim humilioribus; pronoto rude punctato, rugis subelevatis (una centrali longitudinali, altera transversa et ante medium sita) subimpunctatis, angulis posticis elevatis lævigatis, longitudine latitudine postica $\frac{1}{4}$ minore, lateribus ad medium paullo sinuatis; scutello triradiatim calloso-rugoso punctato (ruga ad medium excepta); hemelytris pilosulis haud profunde punctato-rugulosis, corii marginis costalis parte quarta basali recta, deinde sensim rotundato-ampliatis; pedibus mediocribus; mesosterno sulcato, prostethio antice punctato; ventre capillis adpressis pallidis vestito.

♀. Long. 4, lat. 1½ m. m.

Taken by sweeping ferns near the "Lake of Fire" on Mauna Loa, Hawaii, at an elevation of 4000 feet.

30. *Nysius nitidus*, n. sp.

N. elongatus, nitidus, glaber, pallide olivaceo-brunneus, subtus cum pedibus dilutior, capite capillis adpressis aureis vestito, brunneo, tylo, linea longitudinali, orbitulis et tuberculis antenniferis ochraceis, antennis et rostro apice brunneis, his articulo primo (macula interiore excepta), articulis secundo tertioque ochraceis, articulis secundo tertioque ad medium brunnescenti-annulatis; pronoto puncturis, angulis posticis et macula ad medium marginis postici,

scutello basi puncturisque, hemelytris venis, corio angulo apicali lato, femoribus maculis, tibiis ad basin apicemque, tarsorum articulis apicibus, pectore puncturis, gula, linea inter pedes, mesosterno macula media, ventre ad basin necnon maculis connexivi plus minus brunneis vel piceo-brunneis; membrana subhyalina. Capite paullo elongato, ruguloso; antennis gracilibus rostro brevioribus, articulo secundo tertio subæquilongo; rostro coxas posticas superante, articulo primo basin capitis attingente; gula basin capitis haud attingente; bucculis antice altis cito retrorsum humilioribus, plure quam dimidio postico maxime depresso et subæque alto, postice appropinquantibus; pronoto parce et rude punctato, disco longitudinaliter et transversim depresso, rugis longitudinali transversaque elevatis et angulis posticis elevatis lævigatis, longitudine latitudine postica ¼ minore, lateribus subsinuatis; scutello fortiter triradiatim calloso-rugoso, ad latera punctato; hemelytris (margine costali corii excepto) subtilius punctatis, sutura clavi biseriatim punctata, margine costali corii ad basin recto, deinde sensim rotundato et subampliato; pedibus mediocribus; mesosterno sulcato, margine postico paullo elevato.

♀. Long. 5, lat. 1⅔ m. m.

At an elevation of 4000 feet, on Haleakala, Maui.

31. *Nysius nemorivagus*, n. sp.

N. oblongus, nigro-fuscus, rufescenti-ochraceo variegatus, subopacus, parce pallide pilosulus, capite vitta longitudinali interrupta et maculis 2 inter oculos, tuberculis antenniferis apice, antennis articulo primo basi apiceque, articulis secundo tertioque apice, pronoto macula media antica, disco postico (puncturis, ruga longitudinali antice, et maculis 4 irregularibus ad marginem posticum exceptis), scutello apice, clavo maculis nonnullis parvis, corio maculis majusculis (præsertim in disco antico sitis) et margine costali dilatato (limbo angustissimo excepto), pectore ventreque maculis, femoribus (maculis permultis exceptis), tibiis (basi pro parte et apice exceptis), tarsis (articulo ultimo excepto) plus minus rufescenti-ochraceis vel ochraceis; membrana hyalina plus minus fusco variegata. Capite rude punctato; antennis rostro subæquilongis, articulo secundo tertio longiore; rostro coxas posticas subattingente, articulo primo bucculis æquilongo; gula capitis basin attingente; bucculis gula brevioribus antice subaltis, in medio sensim retrorsum humilioribus, postice citius humilioribus et ante apicem gulæ evanescentibus; pronoto rude punctato, ruga longitudinali præcipue postice, ruga transversa et angulis posticis elevatis lævigatis, lateribus subsinuatis, longitudine latitudine postica minore; scutello rude punctato, ruga longitudinali impunctata; hemelytris vix et tenuissime punctulatis, corio margine costali ad basin recto, deinde sensim rotundato-ampliato; pedibus mediocribus; mesosterno sulcato, postice submarginato; ventre segmento quarto postice truncato.

♀. Long. 5, lat. 1½ m. m.

Mauna Kea, Hawaii, and Haleakala, Maui, at an elevation of 5000-6000 feet.

In the specimen described above the membrane is almost unicolorous; in others it is more or less variegated with fuscous.

32. *Nysius rubescens*, n. sp.

N. oblongus, ochraceo-rufescens, capillis adpressis pallidis vestitus, capite macula magna utrinque oculum includente et ad apicem jugæ percurrente, pronoto vitta lata transversa ante lobum posticum sita et puncturis, scutello basi puncturisque, hemelytris maculis parvis, corio limbo antico angustissimo necnon maculis 3 majusculis ad marginem apicalem fusco-nigris; antennis, rostro pedibusque lutescentibus, antennarum articulo ultimo, rostri articulis tertio quartoque, et tarsorum apicibus brunneis vel piceo-brunneis, hemelytris dilutioribus, margine costali dilatato innotato, scutello apice, bucculis, coxis atris ad apicem et acetabulis secundis tertiisque ochraceis, pectore ventreque nigris capillis albidis vestitis, prostethio marginibus, ventre segmentis quarto, quinto sextoque ad medium, et segmentis genitalibus pro parte rufescentibus, membrana albido-hyalina pallide fusco-nebulosa. Capite punctato; antennis rostro paullo brevioribus, articulo secundo quam tertius multo longiore; rostro coxas posticas superante, articulo primo et gula basin capitis attingentibus; bucculis gula paullo brevioribus, retrorsum sensim humilioribus et evanescentibus; pronoto rude punctato, ruga transversa in medio interrupta, macula ante medium marginis postici, margine et angulis elevatis posticis lævigatis, ruga longitudinali obsoleta, longitudine latitudine postica minore, lateribus fere rectis; scutello rude punctato, ruga longitudinali lævigata; corii margine costali ad basin recto, deinde sensim rotundato-ampliato; pedibus mediocribus; mesosterno sulcato, postice marginato.

♀. Long. 5, lat. 1¾ m. m.

On ferns near the "Lake of Fire" on Mauna Loa, Hawaii, at an elevation of 4000 feet.

33. *Nysius pteridicola*, n. sp.

N. ovato-oblongus, brunneo-ochraceus, brunneo variegatus, glaber subnitidus, capite, antennis articulis secundo tertioque ad basin angustissime, rostro articulo ultimo, pronoto ruga transversa puncturisque, scutello, hemelytris puncturis, corio limbo costali angustissimo et angulo apicali, tarsis apicibus necnon corpore subtus plus minus brunneis vel piceo-brunneis; antennis, rostro, pedibus et prostethii margine postico rufo-brunneis; pronoto ruga longitudinali postice et angulis posticis, scutello apice necnon hemelytris venis plus minus pallide ochraceis; membrana albido-hyalina. Capite rugoso; antennis rostro multo brevioribus, articulo secundo tertio longiore; rostro coxas posticas superante, articulo primo basin capitis superante; gulæ longitudine capitis

¼ minore; bucculis gulæ fere æquilongis, antice altis, retrorsum cito humilioribus, pone gulam concurrentibus; pronoto rude et dense punctato, ruga transversa et ruga longitudinali fere obsoleta subimpunctatis, angulis posticis lævigatis, longitudine latitudine postica ¼ minore, lateribus fere rectis; scutello dense et rude punctato fortiter triradiatim rugoso-calloso, ruga longitudinali lævigata; hemelytris dense subtilius rugoso-punctulatis, sutura clavi biseriatim punctata, margine costali fere a basi sensim rotundato et subampliato; pedibus crassis; mesosterno sulcato, postice marginato; ventre segmento quarto postice truncato, segmento quinto obtuse emarginato longitudine media longitudinis lateralis parti quartæ æquilonga.

♂ et ♀. Long. 4½–6, lat. 1½–2 m. m.

Near the "Lake of Fire" on Mauna Loa, Hawaii, at an altitude of 4000 feet.

34. *Nysius vulcan*, n. sp.

N. præcedenti (*Nysio pteridicolæ*) persimilis, differre videtur pronoto remotius punctato, margine costali dilatato corii paullo ampliore, bucculis magis abrupte et minus sensim retrorsum humilioribus, antennarum articulo secundo tertio vix longiore, et præcipue ventris segmento quarto postice angulariter sinuato haud truncato.

♂. Long. 5½, lat. 1¾ m. m.

Mauna Loa, Hawaii.

Very like *Nysius pteridicola* (no. 33) in coloration and general appearance; but the different form of the fourth ventral segment, as well as the other points noted, will serve to separate them. The coloration of the underside differs in a few particulars; but having seen one specimen only, I cannot be sure whether this will afford a constant character.

The Hawaiian Islands seem to be very rich in species of *Nysius*, no less than ten species (all peculiar) having been found there; and of these Mr. Blackburn has discovered nine. When there is reason to believe that the total number of species occurring in the islands is (comparatively) completely known, it will be desirable to give an analytical table of them; in the meantime I have been obliged to describe each at some length, as the species of this genus are often very similar in general appearance.

Nysius must, from its wide distribution, and especially from the occurrence of species in many oceanic islands, be a genus of great antiquity.

35. *Cymus calvus*, n. sp.

C. niger opacus, tylo apice, tuberculis antenniferis, collo loboque postico pronoti, scutello apice, oculis ocellisque, prostethio margi-

nibus antico et postico, metastethio margine postico neenon acetabulis rufo-brunneis; antennis, pedibus hemelytrisque pallide brunneo-flavescentibus; antennis basi et articulo ultimo, coxis, trochanteribus et femoribus ad basin, clavi commissura, pronoto ad marginem posticum, hemelytrorum puncturis et corii angulo apicali plus minus pallide vel saturate brunneis; abdomine ferrugineo-testaceo, ad basin fusco, incisuris pallidioribus, capillis sericeis tenuissimis vestito; pedibus rostroque brunneo-ochraceis, illo apice piceo-brunneo; membrana albida. Capite cum oculis latiore quam longiore, subtiliter punctato, jugis subprominulis et acutiusculis; antennarum articulo primo capitis apicem superante, secundo tertio tertioque quarto longiore; rostro mesosterni medium attingente, articulo primo medium prosterni haud superante; pronoto capillis tenuissimis parcissime vestito, sat rude punctato, anterius rotundato-angustato et hoc modo collo lato instructo, ad medium leviter constricto et transversim impresso, quam margo posticus paullo longiore, margine postico sinuato, ruga centrali longitudinali obsoleta, marginibus antico posticoque, area utrinque lobi anterioris neenon vitta longitudinali ad angulum posticum lævigatis; scutello rude punctato (rugis distinctis longitudinali et transversa exceptis); clavo rude punctato; corio ad margines interiorem et apicalem serie punctorum instructo, disco rude punctato, margine lato costali et arca intima a basi ad marginem apicalem extensa lævigatis; pectore punctato, mesosterno obsolete longitudinaliter sulcato; abdomine apicem corii longe superante.

♀. Long. 5, lat. pronoti posterioris 1½ m. m.

Very rare. Under stones on the mountains near Honolulu, at an elevation of about 2000 feet.

Though I have placed this and the following species in the genus *Cymus*, they seem to differ from it in some particulars, as, for example, in the shorter rostrum, in which point they approach the genus *Arphnus* of Stål, from which, however, the tylus not or scarcely exceeding the bucculæ appears to exclude them. Consequently I have described the species at greater length than I would otherwise have done. The genus *Cymus*, though a small one, is widely distributed, having representatives in the Palæarctic, Oriental, Nearctic, Neotropical, and Australian Regions, and a closely-allied genus in the Ethiopian Region.

It may be noticed that the specimen described above has the second and third joints of the right antenna fused into one, a not uncommon malformation in the Lygæidæ.

36. *Cymus criniger*, n. sp.

C. **griseo-flavescens, capillis crassiusculis pallidis sat bene vestitus; capite, pronoti lobo antico vitta transversa lata, scutello basi, corii clavique angulis apicalibus neenon corpore subtus atris;**

antennis pallide rufo-brunneis, articulo ultimo præcipue ad apicem, tuberculis antenniferis, tylo apice, scutello, prostethii margine antico, acetabulis externe, sternorum abdominisque incisuris saturatioribus; rostro pedibusque brunneo-testaceis, illo ad apicem fusco, horum coxis, trochanteribus et femoribus ad basin fusco-ferrugineis, femoribus subtus fusco maculatis; membrana albida. Capite cum oculis latiore quam longiore, jugis subprominulis et acutiusculis, antennis articulo primo apicem capitis superante, secundo tertio et tertio quarto longiore; rostro coxas anticas vix superante, articulo primo marginem anticum prostethii paullo superante; pronoto punctato, anterius in collum subangustato, lateribus leviter sinuatis, ruga longitudinali obsoleta, disco anterius utrinque, marginibus angustis antico posticoque et linea brevi subelevata ad angulos posticos elevatos lævigatis; scutello (ruga longitudinali excepta) punctato; hemelytris rude punctatis, margine costali dilatato impunctato; mesosterno distincte longitudinaliter sulcato; abdomine apicem corii longe superante.

♀. Long. 5, lat. pronoti posterioris 1½ m. m.

Very rare. Under stones on Haleakala, Maui, at an elevation of 5000 feet.

Though in stature and general appearance resembling the preceding species, this is very distinct from it. It is rather stouter and also broader behind.

Anthocoridæ.

37. *Dilasia* (?) *denigrata*, Buchanan White.

Dilasia (?) *denigrata*, Buchanan White, E. M. M. xvi. 146. 11.

On trees, at an elevation of about 3000 feet, on Mauna Kea, Hawaii.

38. *Dilasia* (?) *decolor*, Buchanan White,

Dilasia (?) *decolor*, Buchanan White, E. M. M. xvi. 147. 12.

On trees in mountain forests near Honolulu.

39. *Lilia dilecta*, Buchanan White.

Lilia dilecta, Buchanan White, E. M. M. xvi. 147. 13.

On trees at an altitude of about 5000 feet, on Haleakala, Maui.

The genus *Lilia* was constituted for the reception of this species, which, with nos. 37 and 38, has been found in the Hawaiian Islands only.

Emesidæ.

PLOIARIODES, n. g.

Caput antice convexiusculum, postice globoso-reflexum. Thorax

trapezoidalis, pronoto marginibus rotundatis, disco ante marginem posticum tuberculo elevato armato. Hemelytra apicem abdominis paullo superantia, corio clavoque angustissimis. Pedes antici corporis dimidio vix longiores, femoribus ad basin biseriatim setuloso-dentatis, trochanteribus haud dentatis, tarsis triarticulatis. Abdomen elongato-obovatum, marginibus reflexis.

Very like *Ploiaria*, Scop., differing only in the unreflexed side margins and tuberculate hind margin of the pronotum.

40. *Ploiariodes Whitei*, Bln., n. sp.

P. pallido ochraceo-brunnea, antennis, pedibus hemelytrisque dilutioribus, his fusco-brunneo maculatis, illis fusco-brunneo annulatis; pedibus subtilissime pilosis; antennis ♂ parce longipilosis.

♂ et ♀. Long. 6½, lat. pronoti 1, lat. corp. postici 1⅜ m. m.

Beaten from dead branches of trees at an elevation of about 4500 feet, on Mauna Loa, Hawaii.

BIBLIOGRAPHICAL NOTICES.

A Treatise on Comparative Embryology. By Francis M. Balfour, M.A., F.R.S. Vol. I. 8vo. London: Macmillan, 1880.

Among the numerous benefits for which zoologists must own their indebtedness to Mr. Darwin, one of the greatest is undoubtedly the impulse given, by the enunciation of his theory of the origin of species, to the study of the embryology of animals. Of course there were embryologists in pre-Darwinian times, and many of the facts revealed by them were among the most interesting offered for the contemplation of naturalists; but the doctrine of the origin of species by descent with modification immediately invested these facts with a new interest. There seemed to be at once a confirmation and a key given to that reproduction in developmental forms of the higher animals of the characteristics of more lowly organisms, which was long since, if somewhat vaguely, recognized. It was only natural to conclude that, if the different living types were genetically related, some trace of the line of descent ought to be found in the phases which they passed through between the first appearance of the embryo and its assumption of the adult form; and observation showed that in fact in many cases the ontogeny of the individual might fairly be regarded as furnishing an abridged sketch of the ancestral development or phylogeny of the species. Of course those naturalists who objected to the doctrine of the genetic evolution of organisms were free also to object to the phrases in which such conclusions as these are couched; but at the same time it must be admitted that the phenomena of the geographical distribution of animals and their succession in geological time, whatever theory of their production we may adopt, are generally in accordance with the results of a theoretical genetic relationship. With the prevalence of such ideas a new significance was given to the phases through which animals pass in their progress to their perfect form; and it is hardly to be wondered at that the study of embryology, taken in its broadest sense, began to be followed with a zeal and energy of which we had no previous conception. The zoological laboratories which have been established in several favourable situations offered every facility for carrying on the most minute and elaborate investigations; individual students of course under such circumstances experienced an increased stimulus to exertion; and the result during the last fifteen years has been a perfect deluge of memoirs, of greater or less merit, treating of the developmental history of animals.

It is to the sifting and summarizing of this vast mass of material, aided by his own investigations, that Mr. Balfour has devoted an enormous amount of labour, the outcome of which is the volume whose title stands at the head of the present article, and for which all zoologists certainly owe him a deep debt of gratitude. The introduction of new ideas in connexion with embryonic development has resulted in such a multiplication of technical terms that many naturalists who have not made embryology their study must often find it difficult to understand the precise nature of the statements made and the arguments used in the discussion even of questions of systematic zoology; and to these Mr. Balfour's book will be an inexpressible boon. But this is the lowest point of view from which we can estimate its usefulness. As a philosophical summary of the results of embryological investigation it must be quite as highly appreciated.

Mr. Balfour commences with an Introduction, in which, after indicating the general purpose and scope of his work, he briefly describes the phenomena of reproduction and its different modes. He then proceeds to describe the nature and development of the ovum and spermatozoon, the maturation of the former and its impregnation, and the subsequent changes produced by segmentation &c. up to the period of the formation of the germinal layers. The general statements are illustrated by references to the phenomena presented by certain groups; and the whole constitutes an admirable sketch of the process of ovular development in the animal kingdom.

These chapters are followed by the section which constitutes the body of the work, systematic embryology, in which the author, after describing the general phenomena resulting in the formation of the germinal layers, and the broad differences in the mode in which this result is brought about, proceeds to describe seriatim the characteristics of embryonic development in all the great groups of the animal kingdom. Criticism of such work would be out of place; we can only say that, so far as we can see, all the most recent literature of the subject has been laid under contribution, and the materials thus obtained worked up into a connected whole with great care and in the clearest and most intelligible manner. Mr. Balfour has appended to each section and subsection of his work a bibliography of the memoirs cited in it; and as these are cited throughout by consecutive numbers, he has reprinted all the separate bibliographies in a connected list at the end of the volume. This is exceedingly convenient for reference. The book is also freely illustrated with woodcuts, most of which are very good, and many of them beautifully executed.

In this first volume only the Invertebrata are treated of; the second, which we hope will not be long in making its appearance, will deal with the Vertebrate animals from the same phylogenetic point of view which is adopted in the present volume, and will also treat of another special department of the general subject, namely the evolution of organs. When completed, the book will certainly constitute one of the most important of recent contributions to the literature of zoology; and whether the author's fear that his attempt at a systematic exposition of the facts of embryology may be regarded in some quarters as "premature" proves to be well founded or not, we are quite sure that the gratitude of those to whom his book will be a perfect godsend will far outweigh any cavils that may be raised against it.

Memoirs of the Science Department, University of Tokio, Japan. Vol. I. Part 1. *Shell-Mounds of Omori.* By EDWARD S. MORSE, &c. 4to. 36 pp., with 18 plates. Published by the University, Tokio, Japan. Nisshuska Printing-office. 2539 (1879).

THE Japanese have taken up the study of Archæology with warmth and earnestness. A native Archæological Society flourishes at Tokio, the Government interdicts the exportation of the antiquities of the country; and it is hoped that the ancient temples, monuments, gateways, idols, and tombs of Japan will be officially protected. Both from its many antiquities and the fidelity of its very ancient records of civilization and history (for nearly, if not quite, two thousand years), Japan is eminently favourable to the study of archæology. The enthusiastic pursuit of science in modern Japan, the institution of the University of Tokio, the advent of many first-class teachers of philosophy and science, and the cultivation of observing and thinking minds among the many willing native students, have given a high standing to all those connected with this state of progress among our scientific brethren in the North Pacific.

The Professor of Zoology at the University of Tokio, Mr. E. S. Morse, had ardently studied prehistoric shell-heaps in Maine and Massachusetts, U.S., for several years in company with Profs. Jeffries Wyman and F. W. Putnam; and he was not long in discovering a large shell-mound on the Yokohama railway at Omori, about six miles from Tokio. With the ready and sympathetic aid of his friends and colleagues, the officials, professors, and students of the University, a very extensive collection of pottery, ornaments, tablets, implements (horn, bone, and stone), bones, and shells was made and arranged; and with the careful and obliging cooperation of Japanese scholars, artists (draughtsmen and lithographers), and printers Prof. Morse has been enabled to produce this excellent fasciculus. It is neatly printed, profusely illustrated, and published altogether in a highly creditable form by the Japanese. The paper being of native manufacture, we may note that, from the composition (by printers unacquainted with English) to the binding, the mechanical production is entirely Japanese.

Excepting the Japanese "imprimatur" and Japanese titles and numerals on the plates (to allow of their being used in a native translation of the work), there is nothing but European appearances about it.

The length of the prehistoric shell-deposit exposed by the railway-cutting is about 89 metres, with a thickness of 4 metres in one place. Another exposure occurs about 95 metres off; and cultivated fields to the south bear evidence of similar deposits. The mound or mounds are nearly half a mile from the shores of Yedo Bay. In some places the sea has receded about six miles in this bay. The former contiguity of these and other shell-mounds to river-banks or sea-coasts, and, in the latter case, the frequent proofs of the local retreat of the sea, are carefully insisted upon.

Objects (implements) found at Omori are:—*Earthen*: cooking-vessels, hand-vessels, ornamental jars, ornamental bead, tablets, spindle-whorl (?), and disk, shaped from the bottom of broken vessel. *Stone* (lava, slate, schist, and jasper): hammers, celts, rollers, skin-dresser (?), and mortar. *Horn*: awls, handle, prongs of deers' antlers, and implements of unknown use. *Bone*: fish-spine needles, bird-bone with two lateral holes, cube from deer's metatarsal, and deer's *os calcis*, probably used as a handle. *Miscellaneous*: arrow-point from boar's canine, and shells used as paint-cups.

Objects (implements) found in other kitchen-middings, but not found at Omori: flint or obsidian implements, arrow-heads, spear-points, scrapers, skinning-knives, mortars and pestles (?), drilling-stones, ornamental stones, stone net-sinkers, pipes, worked shell, wampum, stone beads.

Of bones found at Omori there are remnants of those of man, ape (?), monkey, deer, boar, wolf, and dog, also of a large cetacean and a large tortoise, and of small mammals, of birds, and of fishes. The human bones bear evidence of having been subjected to cannibalism. A fragment of one platycnemic tibia was discovered at Omori; but several were subsequently found in an immense shell-mound at Onomura, in the province of Higo, Island of Kiushiu. Prehistoric shell-deposits are also known at Otaru, on the western coast of Yezo, Hakodate; several also within the city limits of Tokio. These will be described subsequently; but, as far as comparisons have been made of their contents, they appear much to resemble those of Omori, and, like it, are of very remote antiquity.

In one case, however, the removal of part of a canal-bank, made 230 years ago, exposed a shell-heap composed of species *still extant*, without any *ancient* pottery; hence the extinction of the old species found in the mounds of Omori and elsewhere, and the changes of sea-level, were certainly before, probably long before, that date.

The comparison of the Omori pottery with that found in other parts of the world, and the comparison of the ancient with the modern fauna of Omori, are full of interest, and have been worked out with the acumen and experience of a well-trained naturalist and antiquary.

The following is the list of Gasteropods found at Omori:—

Fusus inconstans, *Lischke*.
Rapana bezoar, *Linné*.
Hemifusus tuba, *Gmelin*.
Purpura luteostoma, *Chemnitz*.
Eburna japonica, *Lischke*.
Nassa, sp.
Potamides, sp.
Lampania, sp.
Natica Lamarckiana, *Duclos*.
Turbo granulatus, *Gmelin*.
Rotella globosa, *Gmelin*.

Of the Lamellibranchs in the old mounds there are:—

Arca subcrenata, *Lischke*.
—— inflata, *Reeve*.
—— granosa, *Linné*.
Dosinia Troscheli, *Lischke*.
Cyclina chinensis, *Chemnitz*.
Mactra veneriformis, *Deshayes*.
Mya arenaria, *Linné*.
Cytherea meretrix, *Linné*.
Tapes, sp.
Solen strictus, *Gould*.
Lutraria Nuttali, *Conrad*.
Ostrea denslamellosa, *Lischke*.
——, sp.

The absence (in the old mounds) of edible species now existing in the neighbouring sea shows that, in all probability, a new or modified fauna has come in since the period of these kitchen-middings. So also the relatively large and luxuriant growth (for the most part) of both the shells of mollusks and the bones of mammals found in these mounds have reference to long-past time, previous to the introduction of stages of degeneracy due to changed conditions either of nature or civilization.

An Introduction to the Study of Fishes. By ALBERT C. L. G. GÜNTHER. 8vo. Edinburgh: A. and C. Black, 1880.

OWING to the author's connexion with this journal, we must abstain from giving an ordinary notice of the present volume. We think it due to our readers, however, to call their attention to its appearance, and to indicate its nature in very general terms.

Dr. Günther's work is founded on the notes and other materials got together by him for the preparation of the article "Ichthyology" in the new edition of the 'Encyclopedia Britannica,' and may therefore be regarded to some extent as an expansion of that article. He commences with a history of ichthyological research, which is followed by a general description of the structure of fishes and its modifications in the various groups, leading up to a notice of the reproductive phenomena presented by animals of this class, and their growth and variation during development. Other chapters are devoted to the distribution of fishes in time and space, the latter subject treated at very considerable length, and the whole winding up with a notice of those deep-sea fishes our knowledge of which is mainly due to the dredging-operations of the last few years. The remainder of the volume (more than half) is devoted to systematic ichthyology, and gives the characters of the orders and families and of the principal genera, with notes on the more important points in their natural history. The volume is very freely illustrated.

MISCELLANEOUS.

On a new Species of Papilio *from South India, with Remarks on the Species allied thereto.* By J. Wood-Mason.

In December last the Indian Museum received from Mr. F. W. Bourdillon, of Trevandrum, a small collection of diurnal Lepidoptera, amongst which was a much-worn and tattered example of a female insect, evidently closely allied to the North-Indian *P. Castor* and to the Burmese *P. Mahadeva*, with the same sex of the latter of which it turned out on examination to agree in having the discal markings of the hind wing confined to the median region of the organ, where they form a transverse band of lanceolate spots, instead of being diffused over the whole disk and extending into the cell, as in the former.

About a month ago a few species of butterflies were received from Mr. G. H. Kearney, of the Berkodee Coffee-Estate, Koppa Anche, Mysore; and amongst them is a fine specimen of the male, which proves that the species is, as the above-mentioned female specimen had already indicated, more nearly related to *P. Mahadeva* than to *P. Castor*, and enables me to describe it.

*Papilio Dravidarum**, n. sp.

Allied to *P. Castor* and to *P. Mahadeva* †, but more closely so to the latter, with which it agrees in the form of the wings in both sexes.

Sexes alike, having not only the same form of wings, but also the same general type of coloration as the female of the two described species, the male differing from the female only in the darker and richer tints of its upper surface.

♂. Upperside rich fuscous, of a much lighter shade than in

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* *Dravidæ -arum*; from *Dravida*=common name of South-Indian peoples.

† Moore, P. Z. S. 1878, p. 840, pl. li. fig. 1.

P. Castor or even than in *P. Mahadeva*, and more densely powdered with fulvous scales than in either. Anterior wing with the basal area of a richer and darker shade of brown than the rest of the organ; with four distinct longitudinal lines of fulvous scales in the cell, at the extremity of which is a minute but distinct cream-coloured speck; with the outer portion beyond the cell very densely covered with fulvous scales between the veins; with a marginal row of ochraceous white spots placed at the incisures; and with a submarginal series of nine conical or sublanceolate ochraceous ones, each series decreasing at either end and paling towards the costal margin. Posterior wing with the anterior third of its surface devoid of fulvous scales; with the incisures of the outer margin very narrowly edged with ochraceous white; with a submarginal series of seven strongly and angularly-curved lunules or arrow-shaped spots, the four posterior of which are ochraceous white, and the three apical ones cream-coloured; and with a discal band of seven externally-dentate lanceolate cream-coloured spots, all irrorated with fuscous scales except the anterior two; with the cell and the parts of the wing-membrane external and internal to it tolerably thickly sprinkled with fulvous scales. The wing-membrane, being in *both wings* devoid of fulvous scales in the intervals between the submarginal and incisural markings, presents the appearance of having a submarginal row of dark blotches. Underside less richly and deeply coloured, with the markings, especially the spot at the end of the cell, all slightly larger and white, with the exception of the discal series of the hind wing, which are tinged with cream-colour at their inner points; and with the fulvous scales similarly though not quite so thickly distributed over the fore wing, but evenly sprinkled over the whole of the hind wing. Body lighter-coloured than in *P. Castor*, but marked in identically the same manner.

Length of fore wing 2·2 inches, whence expanse=4·5 inches.

Hab. Koppa Anche, Kadur district, Mysore, South India, at about 2500 feet elevation. Obtained by Mr. G. H. Kearney.

♀. Marked above and below, spot for spot, as in the male, but lighter and less richly coloured, with the spot at the end of cell larger and apparently more distinctly visible on the upperside, and with all the markings (except the submarginal series of the underside of the hind wing, which are white) straw-coloured.

Length of fore wing 2·3 inches, whence expanse=4·7 inches.

Hab. Trevandrum. Obtained by Mr. F. W. Bourdillon.

In the male of *P. Dravidarum* there are visible upon the upper surface of the fore wing a spot at the end of the cell, a submarginal row of conical or sublanceolate spots, and a marginal row of incisural spots; and upon that of the hind wing a discal row of lanceolate spots, a submarginal series of lunules, and incisural spots as in the fore wing.

In the male of the darker-coloured *P. Mahadeva* the incisural spots of the fore wing alone remain; but the hind wing retains its three series of spots, which, however, are all smaller and apparently less clouded with dark scales than in the preceding species.

In the fuscous-black male of *P. Castor* the fore wing may be said to be uniform black, the incisural spots, which alone remain, being so reduced in size as to be barely visible, being, in fact, mere specks confined to the fringe; the hind wing has lost all but the incisural specks (which are similarly confined to the fringe) and the first three or four spots of the discal series, which together form a large and conspicuous cream-coloured blotch divided by the veins. *P. Castor* may, in fact, be described as a rich dead-black insect with a conspicuous cream-coloured blotch near the outer angle of each hind wing.

In *P. Castor*, then, the sexes are, as regards colour and markings, as strongly differentiated from one another as in any species with which I am acquainted; they also differ to some extent in form, the male having the fore wing narrower, with the external margin obviously emarginate, and the hind wing also narrower and produced, with the same margin more deeply incised and lobed than in the female, both pairs of whose wings in form more or less closely * resemble those of both sexes in the other two species.

In *P. Mahadeva* the sexes are also tolerably well, though not so conspicuously, differentiated in point of colour and markings as in *P. Castor*, but not at all in form, the wings being of the same shape in both sexes.

In *P. Dravidarum* the sexes agree perfectly both in form of wings and markings, differing very slightly in colour only; so that but little sexual differentiation has here taken place.

The female of *P. Dravidarum* is scarcely distinguishable, as far as one can tell from a description alone, from that of *P. Mahadeva*, the only differences that I can make out being that in the latter "the fore wings have very small and less distinct submarginal white spots, and no spot at the end of the cell." From that of *P. Castor*, however, it is readily distinguished by having, as I have already pointed out, the discal markings of the hind wing in the form of a transverse band of short lanceolate spots.

At the meeting of the Linnean Society of London held on the 18th March last, a paper by Prof. Westwood on a supposed polymorphic butterfly from India was read. In this memoir the following conclusions are said (*vide* abstract in 'Nature,' vol. xxi. p. 531, April 1st, 1880) to have been arrived at by the author:—"(1) That *Papilio Castor* is the male of a species whose females have not yet been discovered; (2) that the typical *P. Pollux* are females, of which the males (with rounded hind wings having a diffused row of markings) have yet to be discovered; and (3) that the coloured figures given by the author represent the two sexes of a dimorphic form of the species."

With regard to the last of these conclusions I cannot speak, because neither the paintings nor the specimens in question are accessible to me; but, having spoken above as if the opposite sex of *P. Castor* were perfectly well known to naturalists, while, according to Prof. Westwood, it is still undiscovered, I ought perhaps to say a few words about the material on which my remarks are based.

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* The females present an inconspicuous dimorphism, some having retained the primordial form of hind wing, while others have the outer margin of this wing toothed as in the male (*vide infrà*).

Papilio Castor is restricted in its distribution to the slopes and valleys of the hill-ranges of North-Eastern India and to the parts of the plains in immediate contiguity to them, its place being taken elsewhere, as in Southern India, by the new species described in the preceding pages, and in Burmah by *P. Mahadeva*. The Indian Museum possesses specimens from the southern slopes of the Khasi hills (Silhet), from the Sikkim hills (Darjiling), Cherra Punji in the Khasi hills, and the Naga hills; and three males were taken by Lieut.-Colonel Godwin-Austen during the Dafla expedition; in these last, in a large male from Cherra Punji, and in two specimens of the same sex from the Naga hills, the upper surface is dark brown, of a much lighter tint than in nine males recently received from Sikkim (two) and Silhet (seven), which are all brown-black of so dark a shade as to appear quite black except when a strong light falls upon them, when their colour appears brownish; in fact the brown of the former is to that of the latter series of specimens what dark green is to the colour known as "invisible green." In the large Cherra-Punji specimen the short tooth, or rudimentary tail, into which the third branch of the median vein of the hind wing is usually produced, does not extend beyond the line of the other lobes of the outer margin; and one of the three dwarfed winter specimens* captured by Colonel Austen approaches it in this respect; moreover one of the Silhet specimens has this tooth smaller in one wing than in the other; so that this, like secondary sexual characters in general, is subject to variation. It is possibly to difference of station, but probably to long exposure to the vicissitudes of the Calcutta climate, and to the application of benzine and other noxious substances to which they were subjected before I took over the charge of the collection of Lepidoptera, that these brown specimens owe their lighter coloration. However this may be, it may confidently be asserted that it would be impossible for the most inveterate species-maker to discover any character by which to separate them as a distinct species or race from the fresh and consequently dark Sikkim and Silhet specimens. So much for the males.

Of the nine females in the collection referred by me to *P. Castor*, seven, being perfect, can readily be divided into two sets, according to the form of the outer margin of the hind wing:—three (one from Assam, one from Cherra Punji †, and a large one from Silhet) having the third branch of the median vein not produced, and the outer margin of the wing consequently "rounder," being in fact typical *P. Pollux*; and four (two from Silhet* and two from Sikkim †) having that veinlet produced into a small tooth, as in the male. I consider that these two different forms are both females of *P. Castor*, and that the slight differences they present are explained on the supposition, warranted by numerous analogous facts in nature, that the secondary sexual characters acquired by the male have been partially transmitted to some females, but not to others (*P. Pollux*), which have retained the primordial rounded form of wing.

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* The insect figured by Westwood (Arcana Entom. vol. ii. pl. 80. fig. 2) seems to have been a similarly dwarfed and faded individual.

† There is another specimen from Cherra Punji (the largest of all in the collection), with the outer margins of its hind wings so ragged that it is impossible to be quite sure to which form it belongs, though, from its close agreement in other respects with Westwood's figure in the 'Arcana,' as well as with the other insect from the same locality, I should say it is a typical *P. Pollux*.

The fact that the discoidal markings of the hind wing in the two Silhet females with toothed wings are lighter and more distinctly cream-coloured than in any of the females with rounded wings, that the malformed specimen from the same locality (which certainly belongs to the form with toothed hind wings) has these markings in the fourth, fifth, and sixth interspaces (those, that is to say, corresponding to the ones forming the principal part of the blotch in the male) of almost as rich and pure a colour as in that sex, and that one of the two former has the spot at the end of the cell and the submarginal markings of both fore wings obsolete and is thus still further approximated to the male, do certainly seem to me to tell rather for than against the above supposition.

The *Helenus* group of Papilios, to which *Papilio Castor* and its allies unquestionably belong, taken as a whole, presents us with a remarkable series of gradations in the amount of difference between the sexes, comprising, as it does:—one species (*P. Drawidarum*) in which the sexes closely resemble one another in the form of the wings and in colour and markings, and there is only an incipient sexual differentiation; another (*P. Mahadeva*) in which, while agreeing in structure, they differ to a considerable extent in markings and colour, and the secondary sexual characters of the male are much more pronounced; another (*P. Castor*) in which they differ from one another to such a remarkable extent, that no less an authority than Prof. Westwood originally described them under different names, and still maintains their distinctness, and Mr. Wallace* placed them in different groups of the genus—the male having acquired the most pronounced secondary sexual characters (including rudimentary tails), which have been partially transmitted to some females but not to others, and the two forms of female having retained, one of them the form of wings, and both the general style of colouring, characteristic of both sexes in the first-named species; and, finally, others (*P. Helenus*, *P. Chaon*, &c.) in which the male has perfectly transmitted to the opposite sex all the secondary sexual characters (including the long tails) that he had acquired, the female only differing from him in such trifling points as the lighter coloration of the outer half of both wings and the dingier shade of the upper surface generally.

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* There is a third specimen from Silhet in the collection, taken at the same time and place as the other two; but it unfortunately has the hind wings symmetrically malformed at their outer margins, the third lobule on each side being short and angulated, and the fourth being somewhat longer than usual and also angulated. This malformation is interesting as showing in the same specimen the instability of this character, the strong tendency to the assumption of the male form of wing exhibited in the lengthening of the lobule next in order, and the unmistakable "reversion" to the rounded form of wing in the suppression of the rudimentary tail.

It should be mentioned that a gynandromorphous example of the form of female described by Prof. Westwood as *P. Pollux* has been figured and described as *P. Castor* by G. Semper in Wien. entom. Monatschr. 1863, Band vii. p. 281, Taf. 10. In this specimen both the wings of the left side are truly female; but on the opposite side the posterior portion of the fore wing from the first discoidal veinlet to the inner margin on the upperside only, and the anterior portion of the hind wing from the costal margin to the second branch of the subcostal on both sides, exhibit the masculine livery, not unmingled with female characters (*conf.* Westwood in Thes. Ent. Oxon. p. 187).

† The two Sikkim specimens have the tooth less developed and the discal markings of the hind wings exactly like those of the other form (*P. Pollux*).

From these and other facts, we are, I think, entitled to infer the probable descent of all the members of this group from an ancestor with tailless, rounded wings in both sexes, closely resembling *P. Dravidarum*, but with diffused discal markings in the hind wings, and probably also in the fore wings—the conspicuous wing-blotches of *P. Helenus*, *P. Castor*, &c. having apparently resulted from the concentration, so to speak, of such diffused colouring in the direction of the breadth of the wing, just as have the discal bands of short spots in *P. Dravidarum* and *P. Mahadeva* from a similar process of modification in the opposite direction.

If his conclusions are correctly reported, Prof. Westwood's drawings must represent a species different from either of those alluded to herein; and I look forward with much interest to the appearance of his paper.—*Proc. As. Soc. Beng.* 1880, No. 3.

On a highly organized Reptile from the Permian Formation.
By M. A. Gaudry.

M. Roche, director of the Ironworks of Igornay, to whom we are already indebted for several discoveries of curious fossils, has just found, in the Permian, a new genus of reptile, which he has presented to the Museum of Paris. The Igornay animal is the most perfect of those which have hitherto been met with in the Primary formations of France. I propose to name it *Stereorachis dominans*.

In *Stereorachis* the vertebræ present a striking contrast to those of the reptiles of the same deposits. While in *Actinodon* and

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* In his well-known memoir "On the Phenomena of Variation and Geographical Distribution as illustrated by the Papilionidæ of the Malayan Region," in Trans. Linn. Soc. Lond. vol. xxv. pp. 33, 34.

Euchyrosaurus the centra are composed of a median part, or hypocentrum, and two pleurocentra not soldered together, in *Stereorachis* the centra are in a single piece, which adheres to the neural arch; the vertebral column has therefore acquired much more solidity, which has led me to invent the name *Stereorachis*. It must, however, be noted that the centra of the vertebræ were still extremely hollow; their anterior and posterior faces were so concave that they formed two cones united end to end; I would not even assert that there was not a perforation establishing the continuity of the notochord. This is a condition analogous to that of many fishes.

The new genus found by M. Roche presented another mark of superiority over the Reptiles that lived with it. Its humerus had a neuro-arterial canal in its distal part. I had already called attention, in *Euchyrosaurus*, to the rudiments of the arch indicating a tendency to the formation of this canal; in *Stereorachis* the formation was completed. When we find that, besides the neuro-arterial canal, the humerus had its epitrochlea and its epicondyle widened as in those animals in which the supinator and pronator muscles, or the extensor and flexor muscles, are greatly developed, we are led to think that the old quadruped of Igornay had arms more perfectionated than those of existing reptiles.

Stereorachis must have been a carnivorous animal of considerable size; one of its mandibles, although a little broken, measures 18 centims. The upper and lower jaws are armed with conical teeth, deeply immersed in the sockets; their section is nearly circular; they are smooth externally, with a radiate structure in the interior; the front ones are stronger than the rest; an inferior tooth has a crown 32 millims. high; a superior tooth, the point of which unfortunately is broken, must have been at least 40 millims. There is an entosternum which recalls that of the Labyrinthodonts; it is very broad in its anterior third, and narrowed behind; its length is 15 centims. Beside it there is a large nearly quadrilateral bony plate, 14 centims. long and 5 centims. broad; I suppose this to be the homologue of the coracoid and scapula. There is also a curved bone which I believe to be the homologue of the great bone in fishes regarded by Mr. Kitchen Parker as a clavicle (episternum of the Ganocephalous reptiles). I must also notice long arched ribs, formed of two pieces united end to end; a large coprolite; bones of the head with a rugose surface; and hard, brilliant, very fine, long, aciculate scales, as in *Archegosaurus* and *Actinodon*.

In some respects *Stereorachis* shows affinities with the Ganocephala and Labyrinthodonts. In other respects it shows tendencies towards certain genera of the Permian of Russia and the Trias of South Africa, upon which Prof. Richard Owen has made admirable investigations, and for which he has proposed the name of Theriodonts. Perhaps it still more nearly approaches some North-American animals, such as *Empedocles*, *Clepsydrops*, and *Dimetrodon*, ranged by Prof. Cope in his group of Pelycosauria; but at present I know no genus with which it could be identified. It is a curious thing to find such numerous and varied reptiles in the Primary formations, which for a long time seemed to palæontologists to be almost destitute of them. The discovery in the Permian of a highly organized reptile like *Stereorachis*, or those lately indicated in North America by Prof. Cope, leads us to expect others; these animals are so far from the initial state of reptiles to lead us to suppose that before them there were many generations of ancestors, and that some day, no doubt, we shall meet with their remains even in the Devonian.—*Comptes Rendus*, Oct. 18, 1880, p. 669.

A new Genus of Rodents from Algeria.

M. Ferdinand Lataste has recently described a remarkable Rodent, which he obtained in the Algerian Sahara, as the type of a new genus of Muridæ, which he names *Pachyuromys*. It belongs to the subfamily Gerbillinæ; and its most striking external character is its tail, which is short, claviform, greatly swollen, and apparently naked, its minute annulations and fine white hairs not concealing the rosy tint of the skin in the living animal. Still more remarkable is the structure of its skull, in which the auditory bullæ are so greatly developed behind that they are only separated by a groove, about 5 millims. in depth, at the bottom of which lies the foramen magnum. Mr. Alston informs M. Lataste that such a development of the bullæ, both in their tympanic and more especially in their mastoid portions, is not met with in any genus of Muridæ with which he is acquainted, and that a parallel can only be found in the Geomyidæ, in the North-American genus *Dipodomys*.

Pachyuromys Duprasi, of which M. Lataste possesses several living specimens, is a small animal, measuring about 100 millims. in length of head and body, and 40 millims. in that of the tail; the upper parts are fawn-colour, the lower pure white. Its discoverer promises a more detailed description, with figures of the animal and its skull and observations on its habits.—'*La Naturaliste*,' ii. pp. 313–315 (Nov. 15, 1880).

Researches on the Comparative Anatomy of the Nervous System in the different Orders of the Class of Insects. By M. E. Brandt.

In 1879 I had the honour of bringing before the Academy my investigations upon the nervous system of insects[*]. The present note contains the principal results of my comparative researches upon the nervous system in the different orders of the class Insecta.

The *nervous system of the Coleoptera* has been studied in a great many representatives of various families by M. E. Blanchard[†]. This naturalist is the only one who has studied it as a whole; and his profound investigations enriched science with most important facts, now well known in the scientific world. My investigations upon the nervous system of the Coleoptera were made upon 235 species in the perfect state, and upon 36 species in the state of larvæ. The following are the conclusions:—1. Some Coleoptera (*Rhizotrogus solstitialis*) have the subœsophageal ganglion confounded with the thoracic ganglion. The cerebroid ganglia always have convolutions. 2. There are from one to three thoracic ganglia; if there are two or three, it is only the last that is composite. 3. The number of abdominal ganglia is very variable, from one to eight; sometimes there are no separate abdominal ganglia, but they are confounded with the thoracic part (Curculionidæ, Lamellicornia); sometimes the males have more separate ganglia than the females of the same species (in *Dictyopterus sanguineus* the male has eight and the female seven).

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[*] Comptes Rendus, tome lxxxix. pp. 475–477.

[†] Ann. Sci. Nat. 3^e sér. tome v. (1846).

My principal results on the *nervous system of the Hymenoptera* were published in 1875 *.

The *nervous system of the Lepidoptera* had been very little studied†. I have examined it in 118 adult species, and in 48 species in the caterpillar state. 1. All Lepidoptera have two cephalic ganglia; the supraœsophageal ganglion is furnished with convolutions. 2. In most cases there are two distinct thoracic ganglionic masses (Rhopalocera, Crepuscularia, and most of the other groups); the first is simple, while the second is composite. Some have their thoracic ganglia sometimes very close together (*Cossus ligniperda*, *Pygæra bucephala*), sometimes distant (*Zygæna*, *Sesia*, *Hepialus*); an intermediate form also occurs (*Orgyia*, *Notodonta*, &c.), which possesses two thoracic ganglia, the second having a strongly-marked constriction. 3. There are always four abdominal ganglia; *Hepialus humuli* alone presents five.

The *nervous system of the Diptera* was studied in several families by M. Léon Dufour ‡; but in most cases his descriptions are incorrect. My investigations on the nervous system of the Diptera were made upon sixty-five adult species and twenty-nine species of larvæ §. 1. The Diptera have always two cephalic ganglia, well separated from each other by short commissures; and the supraœsophageal ganglion always has convolutions. 2. There is sometimes a single thoracic ganglion (Muscidæ, Conopsidæ, Syrphidæ, Stratiomydæ), sometimes two (Therevidæ, Dolichopodidæ, Xylophagidæ, Bibionidæ); some have three thoracic ganglia (Fungicolæ, Culiciformia, Pulicida). When there are two thoracic ganglia, both are composite; if there are three, it is the last alone that is composite. 3. The number of abdominal ganglia varies from one to eight; and the Muscidæ Calypteræ have no separated abdominal ganglia, these being confounded with the central nervous part in the thorax. Sometimes the number of abdominal ganglia varies in the same species, according to the sex: according to Landois, *Pulex canis* has eight and seven; according to my own researches this is the case also in *P. felis* and *P. irritans*. I have also found that in the male *Leptis* the last ganglion has a constriction, whilst in the female it is compact. 4. The Diptera have a frontal ganglion and two pairs of small pharyngeal ganglia; but they have not the abdominal part of the sympathetic system distinct.

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* Comptes Rendus, tome lxxxiii. pp. 612–614.

† M. Léon Dufour is the only naturalist who has investigated representatives of the different families (Comptes Rendus, tome xxxiv.).

‡ 'Recherches anatomiques et physiologiques sur les Diptères.'

§ The principal results of my researches upon the nervous system of the Diptera were read in October 1877 before the Russian Entomological Society.

The *nervous system of the Hemiptera* has been very little investigated, and comparative studies are wanting. My researches on the nervous system of the Hemiptera extend to seventy species. 1. Some Hemiptera have no separate subœsophageal ganglion, the latter being amalgamated with the medullary part of the thorax. 2. In some (*Pseudophanus*) it is separate, and placed, not in the head, but in the thorax. The convolutions of the cerebroid lobes are never wanting. 3. In some Hemiptera which have two ganglia in the thorax, the first results from the fusion of the first thoracic ganglion with the subœsophageal ganglion. 4. The number of thoracic ganglia varies from one to three: thus *Hydrometra*, *Acanthia*, and *Nepa* have one; two occur in *Pentatoma*, *Lygæus*, &c.; there are three thoracic ganglia in *Pediculus*, but, having no commissures, they are in contact. *Notonecta* presents an intermediate form, having only a single true thoracic ganglion, which, however, possesses a very strongly-marked constriction. 5. The Hemiptera never have separated abdominal ganglia, they being amalgamated with the thoracic part of the nervous system.—*Comptes Rendus*, December 6, 1880, pp. 935–937.

Habits of a Fish of the Family Siluridæ (Callichthys fasciatus, *Cuv.*).

By M. Carbonnier.

I have in my possession several individuals of the species called *Callichthys fasciatus*, Cuv., coming from the river Plate. This species is characterized by two barbels at each angle of the upper lip, two rows of broad and strong scaly plates, which cover the flanks and intercept the lateral line, and two dorsal fins, of which the second (adipose) is furnished like the first with an osseous ray. These fishes, as I have ascertained, come frequently to take in a provision of air at the surface of the water; but their most interesting peculiarity consists in their mode of copulation and reproduction.

At the moment of fecundation the female brings together her ventral fins, after the fashion of two open fans united by their edges, and thus forms a sort of *cul-de-sac*, at the bottom of which the aperture of the ovaries opens. The fecundating elements of the male are imprisoned in this sort of membranous sac; and when, a few moments afterwards, the eggs arrive in the same place, they will find themselves bathed in a liquid very rich in spermatozoids.

Each laying consists of five or six eggs, which the female retains for a few minutes in the pouch above described; then she quits the bottom to go in search of a favourable spot for their evolution. Her choice leads her in preference to a well-illuminated part, such as the glass wall of the aquarium, or a stone that emerges from the water; with her mouth she cleans a place situated at least 10–15 centims. below the level of the water, then, applying her abdomen to this place, she opens her sac and attaches the eggs, which adhere by means of the viscosity with which they are endued.

All the eggs being deposited, contact with the male recommences; and the ovipositions thus follow one another forty or fifty times in the course of the day. I estimate the total number of eggs emitted at about two hundred and fifty*.

At the moment of deposition the eggs, arranged in groups of from three to five, are of a milky white, and but slightly transparent; they afterwards become yellowish, and at the moment of exclusion, *i. e.* from the eighth to the tenth day of incubation, they become blackish: this coloration is due to the pigment spots which cover the body of the embryo.

At the moment of its birth the embryo is globular. At first one can only distinguish the four barbels; the umbilical vesicle, which is semitransparent, is not very voluminous; the embryo holds itself in the normal position, and not lying upon its side, like most embryos of other fishes. Speedily the tail and the other fins appear. These latter developments last on the average three days, during which time these fishes lead an independent and isolated life. When this period is past, *i. e.* from twelve to thirteen days after deposition, all these young fishes collect together and move about the bottom of the aquarium.

The growth of this fish is not very rapid; it does not become adult until two years after its birth.

An interesting fact is the change of the period of reproduction presented by our *Callichthys*. At La Plata it is in the months of October and November that it breeds. After arriving in Europe it passed a year without producing young. In 1878 oviposition took place in August and September. The produce of this generation oviposited this year in the month of June. Evidently there has been an adaptation to our climate, the temperatures of which are the reverse of those of South America.—*Comptes Rendus*, Dec. 6, 1880, p. 940.

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* The layings observed by me always commenced between 9 and 10 o'clock A.M., and terminated about 2 P.M.

On a new Form of Vesicular Worm with Exogenous Budding.

By M. A. Villot.

The curious larva of a Tæniid, which I now propose to make known under the name of *Urocystis prolifera**, is, like the Staphylocystes†, a parasite of *Glomeris limbatus*; but it presents the peculiarity that it lives in the same host in various degrees of development—namely, in the vesicular state properly so called, free in the visceral cavity, and in the state of scolex, encysted in the adipose body.

Urocystis prolifera, in the vesicular state properly so called, presents for our consideration three very distinct parts—a head, a body, and a caudal vesicle. These three parts, which are in perfect continuity of tissue, are invaginated one within the other, the head in the body, and the body in the caudal vesicle.

The head is oval, more or less inflated laterally, truncate in front, and narrowed behind. It bears four sucking-disks and a very long rostellum. The latter deserves to be described in detail. It is invaginated in the head by its posterior extremity, and upon itself by its anterior extremity. From this it results that the head of the worm terminates by a sort of funnel of invagination, having perfectly the aspect of a frontal sucking-cup. The inner wall of this infundibulum presents numerous transverse folds, formed by the contraction of the elastic fibres of which it consists, and is armed with a circlet of hooks so small that it is impossible to count them. These hooks are packed very closely together; and to distinguish them it is necessary to employ a magnifying-power of 600–900 diameters; with lower powers we only see a chitinous ring of a brilliant yellow colour.

The body (*receptaculum capitis*) is united by the neck to the posterior part of the head. It is formed by a very delicate membrane, so closely pressed against the inner wall of the caudal vesicle that it is difficult to distinguish it therefrom. We only remark beneath the neck a sort of pad, formed of embryonic cells, like the parenchyma of the head. The peduncle which unites the body to the caudal vesicle can only be detected with difficulty, in consequence of the transparency and contractility of the tissues and the narrowness of the orifice of invagination.

The caudal vesicle is oval, slightly acuminate in front, obtuse posteriorly. It is formed, as usual, of anatomical elements of two kinds—an outer layer of interlaced elastic fibres, and an inner layer of connective tissue. Its contractility, which is very marked, enables the animal to move in all directions. The scolex occupies only two thirds of its cavity; and there is in the posterior region a very considerable vacancy.

The dimensions of the different parts of the worm are as follows:—hooks 0·001 millim.; diameter of the trunk in the invaginated state 0·03; diameter of the sucking-disks 0·02; length of the scolex in the invaginated state 0·07; length of the caudal vesicle 0·09; breadth of the caudal vesicle 0·06. From these measurements one may judge of the minuteness of our parasite, and the difficulties presented by its study. Its bulk does not exceed that of an Infusorian: and it is evident that it would escape the researches of any observer who does not avail himself of the lens and the microscope.

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* Incorrectly called *Urocystis prolifer* by M. Villot.

† See 'Annals,' ser. 5, vol. i. p. 258.

As indicated by its name, *Urocystis prolifera* is essentially characterized by its mode of multiplication. Its buds are successively developed, and become detached as soon as they have arrived at maturity. Thus its colonies are usually composed only of two individuals placed one behind the other—a completely-developed vesicle in front, and a bud in the form of a caudal appendage. The bud is represented at first only by a small spherical vesicle containing cellular elements in course of proliferation. It is sessile, and in continuity of tissue by its anterior extremity with the individual that preceded it (perfect vesicle or bud); but during development it acquires an oval form, and tends gradually to become isolated. At the moment when the first traces of the scolex make their appearance the two individuals are no longer united to each other except by a thin cord. When it becomes detached, the vesicular bud has acquired its full development, and contains a perfectly-formed scolex. The latter speedily frees itself from its caudal vesicle to go and encyst itself in the adipose body of its host; but the scolex, while abandoning its caudal vesicle, remains encysted in its *receptaculum capitis* and does not evaginate its trunk. The escape of the scolex may be effected either by degenerescence of the caudal vesicle or by rupture of the pedicle which attaches the scolex to the vesicle. The latter mode, which I have frequently observed, appears to me the more natural.

The scolex, in becoming encysted in the adipose body of its host, does not undergo any great modification. There is nothing more than a change of external form and a thickening of the integuments. It becomes spherical; and the embryonic elements which constitute the wall of the *receptaculum capitis* pass to the state of elastic fibres, to replace the caudal vesicle as a protective organ.

No doubt, independently of its habitat, *Urocystis prolifera* has many relations to *Staphylocystis*; but it differs from the latter by important characters which fully justify the establishment of a genus. In *Staphylocystis* the individuals which constitute the colony are developed simultaneously, and do not separate from each other at maturity. The scolex does not issue from the caudal vesicle, and has not its trunk invaginated upon itself.

The other states of this new form of worm are unknown to me, and probably have not yet been described; but we know now that the scolex which must figure at the head of the strobile possesses a long trunk and a simple circlet of very small hooks. As to the definitive host, whether mammal or bird, it certainly belongs to the Alpine fauna. The *Glomeris* which furnished me with *Urocystis prolifera* was captured in the woods of the Grande-Chartreuse.—*Comptes Rendus*, December 6, 1880, p. 938.

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IX.—*History and Classification of the known Species of* Spongilla. By H. J. CARTER, F.R.S. &c.

[Plates V. & VI.]

THE freshwater sponge has been known from a very early period, although perhaps only first publicly noticed in 1696, by Leonard Plukenet, in the following way, viz. "Spongia fluviatilis anfractuosa perfragilis ramosissima" (apud Pallas, No. 4 [*]). Linnæus, in 1745 (No. 2), described two species

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[*] Publications to which reference is made in the following communication:—

1.—1696. PLUKENET, LEONARD. (Brit. Bot.) Almagestum, p. 356, tab. 112. f. 3, "Spongia fluviatilis anfractuosa perfragilis ramosissima."

2.—1745. LINNÆUS. Flora Suecica, Spec. Pl., ed. 1, sp. 11. *Spongia fluviatilis*; ib. sp. 10. *Spongia lacustris.*

3.—1758. LINNÆUS. Systema Naturæ, ed. x.

4.—1766. PALLAS. Elench. Zoophytorum. *Spongia fluviatilis*, No. 231, p. 384.

5.—1816. LAMARCK. Anim. sans Vertèbres, t. ii. p. 98.

6.—1826. GRANT, ROBERT. "On the Structure and Nature of the *Spongilla friabilis*," Edin. Phil. Journ. vol. xiv. p. 270.

7.—1835. GERVAIS, P. "Les Éponges d'eau douce," Ann. des Sc. Naturelles, n. s. t. iv. p. 254.

8.—1839. MEYEN, F. J. F. "Beiträge zur nähern Kenntniss unseres Süsswasserschwammes," Müller's Archiv, 1839, S. 83, apud Lieberunder the names respectively of "*Spongia lacustris*" and "*S. fluviatilis*" (apud Pallas), observing in his 'Systema Naturæ' of 1766, ed. xii. p. 1299, that "Autumnali tempore in hujus poris sparsis globulos cærulescentes magnitudine seminum thymi &c. observavit C. Blom, M.D.;" so that Linnæus then was not only acquainted with the existence of the freshwater sponge, but also with the presence of the little globular bodies (*globuli*) in it, to which our attention will be more particularly given by-and-by, under the term of "statoblasts;" while Pallas, also, in 1766, in his diagnosis of "*Spongilla fluviatilis*," stated, "Massæ interdum aut crustæ informes in stagnantibus aquis; in fluentis forma ramosissima" (No. 4, p. 384). Thus the two species of the present day were foreshadowed both in character and nomenclature.

Subsequently much was written on the subject by various authors, and the name "*Spongia*" more than once changed (see "Literature" apud Johnston, No 10); but that of "*Spon-*

kuhn (No. 14, p. 7); Microscopic Journ. vol. i. p. 42, 1841 (No. 10, p. 154); Valentin's 'Repertorium,' 1840 (No. 21, vol. ii. p. 341).

9.—1840. HOGG, J. "Observations on the *Spongilla fluviatilis*," Linn. Soc. Trans. vol. xviii. pt. 3.

10.—1842. JOHNSTON, G. History of British Sponges &c. *Spongilla*, pp. 149–163.

11.—1848. CARTER, H. J. "Notes on the Species, Structure, and Animality of the Freshwater Sponges in the Island of Bombay," Ann. & Mag. Nat. Hist. ser. 2, vol. i. p. 303.

12.—1849. CARTER, H. J. "A Descriptive Account of the Freshwater Sponges in the Island of Bombay, with Observations on their Structure and Development," ibid. vol. iv. p. 81, pls. iii., iv., and v.

13.—1854. CARTER, H. J. "Zoosperms in *Spongilla*," ibid. vol. xiv. p. 334, pl. xi.

14.—1856. LIEBERKÜHN, N. "Beiträge zur Entwickelungsgeschichte der Spongillen," Archiv f. Anat. u. Physiologie, Heft i. u. ii. pp. 1–19 (Jan.).

15.—1856. LIEBERKÜHN, N. "Beitrage" &c. (Nachtrag), ibid. Heft iv. pp. 399–414, Taf. xv. (May).

16.—1856. LIEBERKÜHN, N. Id. ibid. Heft v. pp. 496–514, Taf. xviii. figs. 8, 9.

17.—1857. CARTER, H. J. "On the Ultimate Structure of *Spongilla* &c.," Ann. & Mag. Nat. Hist. ser. 2, vol. xx. p. 21, pl. i.

18.—1859. CARTER, H. J. "On the Fecundation of the Volvoces, &c. (*Spongilla*)," Ann. & Mag. Nat. Hist. ser. 3, vol. iii. pp. 12–15, pl. i. figs. 12–14 (Jan.).

19.—1859. CARTER, H. J. "On the Identity in Structure and Composition of the so-called 'Seed-like Body' of *Spongilla* with the Winter-egg of the Bryozoa; and the Presence of Starch-granules in each," ibid. vol. iii. p. 331, pl. viii. (May).

20.—1863. BOWERBANK, J. "Monograph on the Spongillidæ," Proc. Zool. Soc. London, Nov. 24, pl. xxxviii.

gilla," instituted for the genus by Lamarck in 1816 (No. 5), has taken precedence of all the rest, whereby we now have *Spongilla fluviatilis* and *S. lacustris*.

It was not, however, until the improvements of the microscope ushered in an era of minuter observation that *Spongilla* was more particularly examined, when Dr. Grant (my kind friend and able teacher) published his "Observations" in 1826 (No. 6). After this, Meyen, in 1839, pointed out that the crust of the sphærula or seed-like body (statoblast) was composed of vertically placed spicula 1-250th to 1-200th of a millim. broad, at whose extremities, near the circumference, more or less toothed little disks are formed (Pl. VI. fig. 11, *a*, *b*), and further that, "besides the larger siliceous spicula within the substance of the sponge, there exist more delicate ones of 1-16th to 1-10th of a millim. long, having upon their surface little points which elongate as their age increases" (apud Johnston, No. 10, p. 154, footnote). Here

21.—1866. Bowerbank, J. Monograph of the British Spongiadæ, vol. ii. pp. 339-344, *Spongilla fluviatilis* and *S. lacustris*; ib. vol. i. p. 262, spicula of the ovaries of *Spongilla*; pl. ix. figs. 201-227, pls. xxii. and xxiii. figs. 217-322 (figures of the "ovaries").

22.—1867. Gray, J. E. "Notes on the Arrangement of Sponges," Proc. Zool. Soc. London, May 9, p. 550, &c. (Potamospongia, classification of).

23.—1867. James-Clark, H. J. "*Spongiæ ciliatæ* as *Infusoria flagellata*," Journ. Boston Soc. Nat. Hist. vol. i. pt. 3, pls. ix. and x.

24.—1868. Carter, H. J. "On a Variety of *Spongilla Meyeni* from the River Exe, Devonshire," Ann. & Mag. Nat. Hist. ser. 4, vol. i. p. 247.

25.—1870. Bowerbank, J. Monograph of the British Spongiadæ, vol. iii. pls. lix. and lx.

26.—1874. Carter, H. J. "On the Nature of the Seed-like Body of *Spongilla*, &c," Ann. & Mag. Nat. Hist. ser. 4, vol. xiv. p. 97.

27.—1875. Carter, H. J. "Notes Introductory to the Study and Classification of the Spongida," ibid. vol. xvi. p. 1, &c.: Potamospongida (pp. 187, 190, and 199).

28.—1877. Dybowski, W. "Ueber Spongillen der Ostsee-Provinzen," Sitzungsber d. Naturf. Gesellsch. zu Dorpat, Bd. iv. Heft 2, 1876, p. 258, Heft 3, 1877, p. 527.

29.—1878. Schulze, F. E. "Untersuchungen über den Bau und die Entwicklung der Spongien. Die Gattung *Halisarca*," Zeitschrift f. wiss. Zoologie, Bd. xxviii.

30.—1879. Metschnikoff, E. "Spongiologische Studien," ibid. Bd. xxxii. p. 349, Taf. xx.-xxiii.

31.—1879. Carter, H. J. "On the Nutritive and Reproductive Processes of Sponges," Ann. & Mag. Nat. Hist. ser. 5, vol. iv. p. 374.

32.—1880. Dybowski, W. "Studien uber die Spongien des Russischen Reiches mit besonderer Berücksichtigung der Spongien-Fauna des Baikal-Sees," Mém. Acad. Imp. d. Sc. de St. Pétersbourg, 7e série, t. xxvii. no. 6.

evidently the minute spicules with "toothed little disks" and "little points" respectively belonged to *Spongilla fluviatilis* and *S. lacustris*. Meyen also stated that the seed-like bodies or sphærulæ of *Spongilla* are "essentially distinct from the sporangia of Algæ, and are similar to what are denominated the *winter-eggs* of polypes" (No. 10, *l. c.*), which having endeavoured myself to illustrate and confirm in 1859 (No. 19), I finally adopted the term "statoblast" (No. 19, p. 340). Lastly, Mr. John Hogg, in 1840, demonstrated beyond question that these "seed-like bodies," or statoblasts, *germinated* in water, and thus reproduced the *Spongilla* (No. 9).

In 1842, Johnston published his work on the British Sponges (No. 10), from which the 'Monograph on the British Spongiadæ' of Dr. Bowerbank is chiefly compiled; and in Johnston's work an epitome of all that had been made known up to the time was given, not only of *Spongilla*, but of every other species of the British sponges that had been noticed, together with descriptions and illustrations from actual observation, not only of these but of many others which he added to them; so that this book is a *sine quâ non* to the student.

A few years after this, brings us to a period in which, besides the reproduction of *Spongilla* through the "seed-like body," one through *sexual elements* was also sought for and discovered. Thus, in 1856, Lieberkühn discovered and figured the ovum of *Spongilla*, together with the spermatozoa (Nos. 14, 15, and 16), which, as regards the ovum, Grant had done in the marine sponges in 1826 (Edin. New Phil. Journ. vol. ii. p. 133, pl. ii. figs. 27–29), and, as regards the spermatozoa, F. E. Schulze confirmed, in 1878, in the marine species *Halisarca lobularis* (No. 29). I take no account of my own observation of "zoosperms in *Spongilla*" in 1854 (No. 13), although the absence of the so-called "ear-like appendages" &c. in the figures of them &c. now seems to indicate that they were such, although in the interval I have doubted this, because the fact was not substantiated after the satisfactory manner in which it was subsequently demonstrated by the sagacious Lieberkühn.

Thus, then, in addition to the "seed-like body" in *Spongilla*, it was shown that the freshwater sponges could be propagated by elements of sexual reproduction like those of the marine sponges.

Shortly after this, my own observations (Nos. 17 and 18), coupled with those of James-Clark in 1867 (No. 23), established the "animality" of *Spongilla*, together with the form of the animal itself, for which, in 1872, I proposed the name "spongozoon" ('Annals,' vol. x. p. 45).

Finally Lieberkühn, observing what had been pointed out by Meyen in 1839, viz. that the seed-like body of *Spongilla* was partly composed of "little toothed" amphidisks, and that besides these there were others with "little points" or spines on their surface ("rauhen etwas gekrümmten"), made these the distinctive characters of *Spongilla fluviatilis* and *S. lacustris* respectively (No. 16, pp. 510, 511). This was confirmed by Bowerbank in 1863 (No. 20, p. 7, pl. xxxviii. fig. 1, *b*, *c*, and p. 24, *ib.* fig. 14, *c*); and good representations of these sponges were given by him in 1870 (No. 25, pls. lix. and lx.); but unfortunately the amphidisk or birotulate is omitted in the former, viz. that illustrating *S. fluviatilis*. Descriptions of the two species, as well as illustrations of the seed-like bodies and their spicules respectively, were also published by Dr. Bowerbank in 1866 (No. 21).

Thus the two species of *Spongilla*, hitherto doubtfully distinguished from ignorance of these more decided differences, were firmly established.

Having premised all the circumstances connected with the history of the freshwater sponge (*Spongilla*) that are necessary for the present occasion, we find that they are quite as much advanced physiologically as those of the marine species; and although the latter must ever be by far the most numerous, from the great extent of area producing them, yet, when we remember how few known species of *Spongilla* there are compared with the comparatively large area of freshwater which they may be inferred to inhabit, while the localities of the area in which they have been found are, with the exception of Europe, "few and far between," and as yet from Africa none at all have been described, it may also be inferred that hereafter a great many more species will be added to those with which we are at present acquainted, while the latter are already sufficiently numerous and diversified to render a classification of them desirable for further advancement.

This classification should, of course, be based on some peculiar and persistent characters which may yet admit of modified addition; and as we have seen that until Meyen had pointed out the form and presence of spicules in the seed-like body, no reliable distinction existed between *Spongilla fluviatilis* and *S. lacustris*, so we may assume that this may be anticipated throughout the family. And such is the fact; hence the classification which I am about to propose will be based chiefly on the spicules of the statoblast.

Up to the present time no species of marine sponge has been found to present a statoblast; while those of the freshwater sponge, although *specimens* are often without any (like the mycelium of "dry rot," *Merulius lachrymans*, which may destroy the woodwork of a whole mansion without putting forth its fructification in more than half a dozen places), might be assumed to be capable of producing them in every instance. So here we possess a sharp line of demarcation between the marine and freshwater sponges; for I have examined the type specimen (now in the British Museum) supposed by Dr. Bowerbank to show the existence of the seed-like body in his marine genus *Diplodemia* (No. 25, pl. lxx. fig. 12 and No. 21, vol. i. pl. xxiii. fig. 234, and vol. ii. p. 357), and find that this is nothing more than an insignificant portion of egg-bearing *Isodictya* adherent to the valve of a *Pecten*.

As already stated, Meyen considered the "seed-like body" of *Spongilla* to be equivalent to the "winter egg" of the polyp (Polyzoa); and, as before stated, I have endeavoured to confirm this view by parallel description and illustration (No. 19); while Prof. Allman having proposed the name "statoblast" for the winter egg of the freshwater Polyzoa (Monograph, Ray Society, 1856), must be my reason for calling the seed-like body the "statoblast" of *Spongilla*.

Describing the statoblast generally, it may be said to be in size about as big as a pin's head, varying in this respect, not only with the species but in the individual. For the most part it can be seen with the naked eye, and therefore does not differ much in size from the ova and embryos (swarmspores) of both the freshwater and marine sponges. In form it is more or less globular or elliptical (Pl. V. figs. 1 and 4), and of a whitish colour when fully developed, with a hole either lateral or terminal on the surface, generally at the bottom of an infundibular depression which leads to the interior (fig. 1, *h*, and 4, *e*, &c.). If we now make a vertical section through the hole or aperture of one of these bodies when dry (for this is the best time) with a sharp thin knife, we may observe that it consists of an internal, globular, axial cavity filled with a soft waxy substance of a yellowish colour, like that of dried yelk of egg (fig. 1, *a*, &c.); which substance, on microscopic examination, when swollen out in water, will be found to be composed of a great number of extremely thin, transparent, spherical sacs, filled respectively with minute germinal matter consisting of transparent germs or cellulæ of different sizes; the whole enclosed by a delicate, globular, transparent, investing membrane (fig. 1, *b*) slightly protruding at the aperture (fig. 1, *i*), and presenting a reticulated appearance like that of vegetable cell-structure when compressed *minus* any granules (fig. 12, *f*). (For further detail respecting these parts, see Nos. 12, 17, and 19.) Outside this follows a comparatively thick, translucent, homogeneous membrane, seemingly composed of chitine, whose amber colour being reflected through the "axial" substance gives the latter in the section a deeper tint than it is found to possess when separate; this will be called the "chitinous coat" (fig. 1, *c*). Then comes another kind of coat, composed, in two instances, of cell-structure, which is almost evident under a doublet (fig. 3, *d* and *i*), as will be seen hereafter, but in the rest of a white granular substance (fig. 2, *a*) that will presently be more particularly described, which can only be resolved into such by a very high compound power; and this will be called the "crust" (fig. 1, *d*); it appears to afford a floating property (like cork) to the statoblast, but varies very much in thickness, not only according to the amount of its development, but according to the species. The "crust," again, is charged with, or accompanied by, minute spicules of different forms, variously arranged according to the species, which will be found by-and-by, as before stated, to yield the chief characters of our classification (fig. 1, *g*, and fig. 2, *b*, *c*). At the "aperture," of course, these two coats are deficient, while the interior or chitinous one is prolonged into it by a tubular extension, generally in proportion to the thickness of the "crust" (fig. 1, *h*).

Meyen thought that the substance of the "crust" was composed of "carbonate of lime having a cellular structure" (No. 10, p. 154); but in no instance have I found it to effervesce with acids, while, on the contrary, after boiling it for some time in strong nitric acid it leaves a floccular residue, which may be assumed to be a colloid form of silica, unless it be undissolved tissue. As before stated, in some instances the cell-structure, being comparatively large, is perfectly evident, while in others it is only resolvable under a very high magnifying-power (at least 450 diameters), when it may be termed "microcell-structure," presenting under ordinary circumstances a white granular appearance, which, filling up the intervals between the spicules, imparts to the fully developed statoblast the light colour before mentioned. It floats in water, and is very much like "pith," without apparent cell-structure, is unaffected by liquor potassæ, and untinged by iodine, while before the blowpipe it burns off without leaving any perceptible residue. The floating-power of this substance is very considerable; for it keeps on the surface the whole of the internal contents, which swell out and sink to the bottom the moment they are liberated by section in water, while the remnants of the crust themselves continue to float with the greatest pertinacity. Still, although in most instances where the statoblast is fully developed it forms a thick coat, yet in others it can hardly be traced even under the microscope after the fully developed statoblast has been mounted in balsam; while it must not be forgotten that, as its development is progressive, it may be as *un*traceable at an early period in one as in the other.

Lastly, there is often a distinct layer of spicules which are more like those of the skeleton than those of the statoblast, but sufficiently differentiated by their peculiarities from both to show that they do not belong to either (Pl. VI. fig. 8, *l*, *n*); and these form a very distinct capsular covering to the statoblast, in which probably it was originally developed, and thus separated from its neighbours.

Generally the statoblasts are situated towards the base or first-formed portions of the *Spongilla*, either fixed to the object on which the sponge may be growing, or more or less scattered throughout its structure. The details of their development may be found in the papers to which I have last alluded; while, as this is also progressive, they often present themselves in a collapsed hemispherical state, without the crust, when the chitinous coat, being uncovered, gives them an amber colour, and thus their appearance generally is that of a different kind; but, as before stated, the statoblast when fully developed is, especially in the fresh state, globular, and, in proportion to the thickness of the crust, more or less white in colour. Yet there is a crustless spherical form, wherein too the aperture may be multiplicate—that is, double, triple, or even quintuple (Pl. V. fig. 5, *c c c c c*)—as first noticed in another species by Gervais (No. 7); with which also there appear to have been statoblasts that contained two or three others of the same kind presenting the same structure, the same composition, and the same yellowish colour (apud Johnston, No. 10, p. 154); so that, as before stated, the statoblast, although generally globular or elliptical, may have these forms modified in a variety of ways, as indeed may be seen in those which I have figured in Plates V. and VI.

Now, as the statoblast has so far been found in nearly all the freshwater sponges that have been described, and never in the marine ones, while the form of the skeleton-spicule is not only always acerate but almost always more or less alike in all, it follows from the latter being of little or no specific value that the statoblast, which is different in all, at least in the form of its spicules, must become the basis of the most reliable classification; and therefore I shall use its characters for what in this respect I may hereafter have to propose.

No attempt to classify the freshwater sponges had been made up to the publication of the late Dr. J. E. Gray's "Notes" in 1867 (No. 22, p. 491), when my dear old friend (alas! now only dear to memory) made them the seventh order in his "proposed" arrangement of the Spongida generally, under the terms "Potamospongia," family "Spongilladæ," with the following genera, viz.:—1. *Ephydatia*; 2. *Dosilia*; 3. *Metania*; 4. *Acalle*; 5. *Drulia*; 6. *Eunapius*; and 7. *Spongilla*; adding Dr. Bowerbank's *marine* species *Diplodemia* as an eighth genus—an incongruity arising from the misconception of Dr. Bowerbank to which I have already alluded. If Dr. Gray's "Notes" had been based on direct knowledge of the species of *Spongilla* themselves, and not on Dr. Bowerbank's "Monograph" (No. 20), it might have been unnecessary now to propose a different arrangement. It is enough to state of this "Monograph" that Dr. Bowerbank therein calls the statoblasts "ovaries," and in speaking of them in *Spongilla gregaria* (No. 20, p. 15) thus expresses himself—"The gregarious habit of these ovaries," &c.—to show the fallacies that might arise from such loose phraseology. But setting aside this and the like (for there is much to redeem it), I have had before me, in addition to the publications under reference, the actual specimens, while going through the late Dr. Bowerbank's collections for the British Museum (where they now are); and it has been from examination of these type specimens, together with my own from the island of Bombay, which were described, illustrated, and published long before Dr. Bowerbank's "Monograph of the Spongillidæ," that I have been induced to propose the following classification.

As may have been observed, in my "Notes introductory to the Study and Classification of the Spongida," in 1875 (No. 27), I found it necessary to make the freshwater sponges the fifth family of my sixth order of the Spongida generally, under the name of "Potamospongida," with a single group, at present named "Spongillina." Hence so far they will stand thus:—

Class SPONGIDA.

Order VI. HOLORHAPHIDOTA.

Char. Possessing a skeleton whose fibre is entirely composed of proper spicules bound together by a minimum of sarcode. Form of spicule variable.

Family 5. **Potamospongida.**

Freshwater Sponges.

Group 19. *SPONGILLINA.*

Char. Bearing seed-like reproductive organs called "statoblasts."

Genera: 1. *Spongilla*; 2. *Meyenia*; 3. *Tubella*; 4. *Parmula*; 5. *Uruguaya.*

SPONGILLA.

Gen. char. Skeleton-spicule accrate, smooth, curved, fusiform, pointed, sometimes more or less spined or more or less inflated in the centre; sometimes accompanied by flesh-spicules. Statoblast globular, crust thick, thin, or absent altogether, accompanied by or charged with minute acerates (Pl. V. fig. 5, *b b, d*, &c.), smooth or spined according to the species, arranged tangentially.

* *Minute accrates smooth.*

1. *Spongilla Carteri*, Bk.

Spongilla Carteri, Bk., No. 20, p 31, pl xxxviii. fig. 20; provisionally *S. friabilis*, Lam., No. 12, p. 83, pl. iii. fig. 3.

Massive, sessile. Colour greenish or faint whitish yellow. Structure fragile, crumbling. Skeleton-spicule smooth, fusiform, curved, gradually † sharp-pointed. Statoblast globular; aperture infundibular; crust composed of pyramidal columns of dodecahedral or polyhedral cells, hexagonal in the section, regularly arranged one above another, in juxtaposition, perpendicularly to the outside of the chitinous coat on which they rest; surrounded by a layer of minute, fusiform, curved, and gradually sharp-pointed, smooth acerates (No. 19, pl. viii. figs. 1-3).

Loc. Bombay.

2. *Spongilla paupercula*, Bk.

Spongilla paupercula, Bk., No. 20, p. 32, pl. xxxviii. fig. 21.

Coating and branching. Skeleton-spicule curved, fusiform, sharp-pointed, smooth. Statoblast globular; spicules curved, fusiform, gradually sharp-pointed, smooth.

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† "Gradually," in contradistinction to "abruptly" sharp-pointed (See Pl. VI. figs. 14 and 15 respectively).

Loc. Water-pipes of Boston &c., U.S.

Obs. Mr. Thomas H. Higgin, F.L.S., of Liverpool, kindly sent me a specimen from the same locality, viz. the water-pipes of Boston, which, when examined, proved to have a similar skeleton-spicule, among which there are a number of minute, curved, fusiform, sharp-pointed acerates so like the flesh-spicules of *Spongilla lacustris* that, in the absence of statoblasts, I am led to consider it the same species; and if I am right, then the spicules of the statoblast should be spined, while those of *S. paupercula* were of the "same form as those of the skeleton, but not more than half their size;" so these would be more like statoblast-spicules of *S. Carteri.* My description of *S. paupercula*, Bk., is an abbreviated one of that given by Dr. Bowerbank himself (*l. c.*).

3. *Spongilla navicella*, Carter, n. sp.

(Pl. V. fig. 4, *a*–*g*.)

Sponge unknown. Skeleton-spicule curved, fusiform, smooth, gradually sharp-pointed. Statoblast adherent to the twig on which the sponge had grown; globoelliptical (fig. 4); aperture terminal, infundibular (fig. 4, *e*); no apparent crust; chitinous coat (fig. 4, *c*) encased with a dense layer of minute, stout, short, thick, more or less curved, fusiform, smooth acerates, variable in size, becoming so short internally (that is, where they are in immediate contact with the chitinous coat) as to be trapezoidal, or like a little boat or "cocked hat," according to the direction in which they are viewed; arranged tangentially, crossing each other (fig. 4, *d* and *g*).

Loc. River Amazons.

Obs. A few of the statoblasts were found on a small twig in company with *S. reticulata*, Bk., and *S. paupercula*, Bk., in the Bowerbank collection. They bear evidence of the existence in the river Amazons of a species of *Spongilla* whose entirety is as yet unknown; and it is very probable that a further search there would find many such.

** *Minute acerates spined.*

4. *Spongilla lacustris*, Linn.

Spongilla lacustris, Bk., No. 20, p. 24, pl. xxxviii. fig. 14; also No. 21, vol. ii. *l. c.* and vol. i. p. 342; also No. 25, pl. lx. and No. 16, pp. 510, 511.

S. lacustris auctt.

Branched; branches long, round, and sharp-pointed. Colour dark brown. Structure fibrous. Skeleton-spicule (Pl. VI. fig. 14) curved, fusiform, gradually sharp-pointed, smooth, sometimes more or less spiniferous. Flesh-spicule thin, curved, fusiform, gradually sharp-pointed, spined throughout. Statoblast when fully developed globular; aperture infundibular; crust composed of granular cell-structure, charged with more or less curved, minute, stout, fusiform, sharp-pointed acerates covered with stout recurved spines, arranged tangentially or centrifugally, like the lines of a so-called "engine-turned" watch-case.

Loc. England and Europe generally; North America; Asia, Lake Baikal (*Dybowski*).

5. *Spongilla alba*, Carter.

Spongilla alba, Carter, No. 12, p. 83, pl. iii. fig. 4; also No. 20, p. 25, pl. xxxviii. fig. 15.

Massive, spreading, subbranched. Structure fragile, tomentose. Colour whitish. Skeleton-spicule curved, fusiform, gradually sharp-pointed, smooth. Flesh-spicule thin, curved, fusiform, covered with spines, longest in the centre, where they are vertical and obtuse. Statoblast globular; aperture infundibular; crust thick, white, composed of granular cell-structure charged with minute, thick acerates, which are curved, cylindrical, round at the ends, covered with spines (especially about the extremities, where they are longest and much recurved), arranged tangentially, intercrossing each other like the lines of an engine-turned watch-case.

Loc. Bombay.

Obs. The spicules of the statoblast here, as well as in *Spongilla lacustris*, are considerably stouter, more curved, cylindrical, and more coarsely spined than the flesh-spicules of the sponge generally.

6. *Spongilla cerebellata*, Bk.

Spongilla cerebellata, No. 20, p. 27, pl. xxxviii. fig. 16.

This *Spongilla*, which appears to me to be only a variety of the foregoing species, differs from it chiefly in the absence of the "flesh-spicule," in addition to what Dr. Bowerbank has mentioned (*l. c.*).

Loc. Central India, Aurungabad.

7. *Spongilla multiforis* *, Carter, n. sp.
(Pl. V. fig. 5, *a–d.*)

Massive, incrusting. Colour dark brown. Structure fragile, fibrous, like that of *S. lacustris.* Skeleton-spicule curved, fusiform, gradually sharp-pointed, smooth, often inflated in the centre. Statoblast spherical (fig. 5); apertures in plurality (one to five) (fig. 5, *c c c c c*), on a level with the chitinous coat (fig. 5, *a*), as there is no apparent crust; surrounded by a layer of minute, curved, fusiform, sharp-pointed, spinous acerates, which are in contact with the chitinous coat, arranged tangentially (fig. 5, *b* and *d*).

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* *multiforis*, with many doors or openings (in allusion to the plurality of the "apertures").

Loc. Chiluk-weyuk Lake, British Columbia, lat. 49° 10′ N., long. 121° 22′ W.

Type specimen in the British Museum, presented by Dr. Lyall. Register no. 64. 8. 11. 1–10; running no. 239.

Obs. As the statoblasts, although very numerous, are all empty, it is probable that the germinal matter has passed out of them, and therefore that they are only the effete remains of this organ, although still covered by the statoblast-spicules, as represented in the illustration.

8. *Spongilla Lordii*, Bk.
(Pl. VI. fig. 13, *a–f*.)

Spongilla Lordii, Bk., No. 20, p. 28, pl. xxxviii. fig. 17.

Sessile, incrusting reeds (fig. 13, *f*); surface even. Structure fragile, crumbling. Colour light brown. Skeleton-spicule curved, fusiform, gradually sharp-pointed, smooth, often inflated in the centre. Statoblast hemispheroidal, flat bottle-shaped, forming a single layer in juxtaposition round the reed, underneath the sponge, with the aperture upwards (figs. 13 and 13 *f*); chitinous coat hemispheroidal (fig. 13, *a*); aperture prolonged from the summit by a short tubular extension (fig. 13, *b*, *c*); colour dark amber, followed by a thin granular crust charged with small curved, fusiform, spined acerates, round at the extremities, arranged tangentially (fig. 13, *d* and *e*).

Loc. Lake Osogoos, Cascade Mountains, British Columbia.

Type specimen in the British Museum. Register no. 68. 8. 17. 1–7; running no. 211. Presented by J. K. Lord, Esq.

9. *Spongilla nitens*, Carter, n. sp.
(Pl. V. fig. 3, *a–k*, and Pl. VI. fig. 18.)

Form of sponge unknown to me. Structure reticulate; fibre rigid, composed of bundles of spicules united by transparent colourless sarcode, which in the dried state gives it a hardness and vitreous appearance like that of *Spongilla corallioides*, Bk. Skeleton-spicule curved, cylindrical, smooth, sometimes very slightly inflated in the centre and at the extremities, which are round (Pl. VI. fig. 18). Statoblast globular (fig. 3); aperture infundibular (fig. 3, *g*); crust composed of pyramidal columns of dodecahedral or polygonal cells, hexagonal in the section, regularly arranged one above another, in juxtaposition (fig. 3, *d* and *i*), perpendicularly to the outside of the chitinous coat (fig. 3, *c*), on which, by the intervention of a layer of the statoblast-spicules (fig. 3, *e*), they rest, surrounded by a layer of minute, fusiform, curved acerates thickly spined, especially over the ends, where the spines are longest and recurved (fig. 3, *k*), arranged tangentially (fig. 3, *f*); the same kind of layer immediately round the chitinous coat, where the spicules appear to be intermixed with the lower cells of the crust, leaving the latter free between the two (fig. 3, *e*).

Loc. Unknown.

Obs. Of this species I can state nothing more than that a small fragment appeared in the Bowerbank collection labelled "*Spongilla*, new species, from the Jardin des Plantes." While it affords another instance of the crust of the statoblast being composed of apparently hexagonal cell-structure like that of *Spongilla Carteri*, the rigidity and vitreous appearance of the skeletal structure, if not the form of the spicule also, allies it to *Spongilla corallioides*, Bk., which will be seen hereafter to come from Uruguay. Finally, as this peculiar rigidity of the skeletal structure has in addition only been found in two species of *Spongilla* (viz. *S. Batesii* and *S. reticulata*, Bk.) from the river Amazons, it may be assumed that *S. nitens* also comes from South America. The presence of a layer of statoblast-spicules on the inside as well as on the outside of the crust will be seen by-and-by to occur also in the statoblast of *Parmula* (*Spongilla*) *Batesii*.

MEYENIA[*].

Gen. Char. Skeleton-spicule acerate, curved, fusiform, sharp-pointed, smooth, sometimes more or less spined, or more or less inflated in the centre. Statoblast globular or elliptical; crust composed of the granular structure mentioned, charged with birotulate spicules, *i. e.* spicular bodies which consist of a straight shaft terminated at each end by a disk, even or denticulated at the margin (Pl. V. fig. 6, *h*, &c.), arranged perpendicularly around the chitinous coat, so that one disk is applied to the latter, while the other forms part of the surface of the statoblast (fig. 6, *e*).

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[*] "*Meyenia*," after Meyen, who first pointed out that the statoblast was partly composed of birotulate or amphidiscal spicules (*l. c.*).

* *Margin of disks even.*

1. *Meyenia erinaceus.*

Spongilla erinaceus, Ehr. apud Lieberkuhn, No. 15, p. 509.

Of this species Lieberkühn says, "Zeichnet sich durch Nadeln aus, welche auf ihrer Oberfläche mit kleinen Stacheln versehen sind;" but the spinous character of this spicule *here* does not appear to be such a valuable character, in a specific point of view, as the disks of the birotulate spicule of the statoblast, which Lieberkühn describes in the following page to be without denticulation, and represents as umbonate with even circular margin and short shaft (No. 15, Taf. xv. fig. 31).

Loc. River Spree, Berlin.

Obs. This sponge appears otherwise, *i. e.* in structure and spiculation, to be like *Meyenia fluviatilis.* I do not know where Ehrenberg has described it.

2. *Meyenia Leidii.*

Spongilla Leidii, Bk., No. 20, p. 7, pl. xxxviii. fig. 2.

Thin, sessile, coating. Surface tuberculated, minutely hispid. Structure friable, crumbling. Skeleton-spicule curved, fusiform, abruptly sharp-pointed, sparsely spiniferous, becoming much smaller and more spined round the statoblasts. Statoblast globular, aperture infundibular; crust composed of granular substance charged with birotulate spicules possessing very short shafts and evenly margined smooth umbonate disks, both of which have the margins more or less everted or turned outwards (that is, *from* the statoblast), arranged perpendicularly on the chitinous coat.

Loc. Schuylkill river, Pennsylvania.

3. *Meyenia gregaria.*

Spongilla gregaria, Bk., No. 20, p. 14, pl. xxxviii. fig. 7.

Sponge unknown. Skeleton-spicule cylindrical, stout and rather short. Form of statoblast not mentioned; crust charged with birotulate spicules composed of a short thick shaft terminated at each end by a simple umbonate disk with even circular margin, arranged perpendicularly to the chitinous coat. Spicules in the immediate neighbourhood of the statoblast cylindrical, slightly curved, and abundantly spiniferous, varying considerably in size.

Loc. River Amazons.

Obs. Having no specimen of this species to refer to, I got Mr. Stuart Ridley, F.L.S., of the British Museum, to examine the mounted specimens of *Spongilla gregaria* and *S. reticulata*, Bk., for me, since, although I have taken my diagnosis from Dr. Bowerbank's descriptions and illustrations (*l. c.*), still, as the skeletal spiculation of the former is almost precisely that of the latter, which covered the twig on which the statoblasts *alone* of *S. gregaria* were found, to the extent of "five inches," it seemed to be by no means impossible that the spiculation of the two species might have been confounded. Mr. Ridley's drawings are confirmatory of this possibility; and thus the skeletal spiculation given by Dr. Bowerbank to *S. gregaria* becomes nearly identical with that of the foregoing species, viz. *S. Leidii*, Bk.; but while the ends of the spicules are abruptly *pointed in the latter*, they are *equally round* in *S. reticulata* and those stated by Dr. Bowerbank to characterize the skeletal spicule of *S. gregaria.*

Undoubtedly we have the same sparsely spined skeleton-spicule becoming smaller and thickly spined in the immediate neighbourhood of the statoblasts in *S. Leidii*, *S. gregaria*, and *S. reticulata*, together with absolutely smooth skeleton-spicules in all three, if those assigned to *S. gregaria* by Dr. Bowerbank be the right ones. Thus the skeletal spicules and the spicules of the statoblasts in *S. Leidii* tending to the characters of those assigned to *S. gregaria*, in spite of the roundness of the ends of the skeletal spicules in the latter, seems to point out that the spinous element existed in both, and that generally they are closely allied; but, after all, it does not satisfy our doubt as to whether the round-ended spicules did not belong to *S. reticulata.* Further observation is required to decide this.

** *Margin of disks denticulated.*

4. *Meyenia fluviatilis.*

Spongilla fluviatilis, Bk., No. 20, p. 7, pl. xxxviii. fig. 1; also No. 21, vol. ii. p. 339; vol. i. pl. xxii. figs. 317–319; and No. 25, vol. iii. pl. lix.
Spongilla fluviatilis auctt.

Massive, lobate. Structure friable, crumbling. Colour light yellow-brown. Skeleton-spicule curved, fusiform, gradually sharp-pointed, smooth, often spined and often centrally inflated, Statoblast globular; aperture infundibular; crust thick, composed of the granular or microcell-substance, charged with birotulates whose umbonate disks are deeply and irregularly denticulated (Pl. VI. fig. 11, *a*, *b*), arranged parallel to each other and perpendicular to the chitinous coat.

Loc. England and Europe generally.

Obs. Here, as elsewhere, in proportion to the thickness of the crust is the length of the infundibular aperture, which is partly lined by a tubular extension of the chitinous coat.

Spongilla Meyeni, Carter.

Spongilla Meyeni, Carter, No. 12, p. 84; and No. 20, p. 10, pl. xxxviii. fig. 4.

Loc. Bombay.

Spongilla fluviatilis, var. *Parfitti*, Carter.

Spongilla fluviatilis, var *Parfitti*, Carter, Ann. & Mag. Nat. Hist 1868, vol. i. p 247, and Bowerbank, 1870, No. 25, p. 298, pl. lxxxvi. figs 5-11.

Loc. River Exe, Devonshire.

Obs. Having specimens of all three of these sponges now before me, I cannot help thinking that the occasional differences of spiculation in one may be seen in the other, and therefore that *S. Meyeni* and *S. fluviatilis*, var. *Parfitti* are mere varieties of *S. fluviatilis*=*Meyenia fluviatilis*, nobis. Of the two specimens of *S. fluviatilis*, var. *Parfitti*, that I have mounted, nearly all the skeleton-spicules in one are smooth, and nearly all those in the other are spiniferous, which shows what an admixture of these two kinds of spicules *may* exist in *Meyenia fluviatilis*. It is convenient here to allude to

Spongilla sceptrifera, Bk.

Spongilla sceptifera, Bk, No. 25, p. 300, pl. lxxxvi. figs. 15-17.

Loc. Reservoir, Exeter.

Obs. This pretended *new* species is no "new species" at all, but probably *S. fluviatilis*, as the statoblast would have proved if any had been present; for *S. fluviatilis* grows abundantly in the same locality, and the characteristic spicule represented by Dr. Bowerbank (*l. c.* fig. 17) is nothing more than a detached frustule of the diatom *Asterionella*, like *A. formosa* (Pritchard's Infusoria, ed. 1861, pl. iv. fig. 17), which, in its entirety (that is, with the frustules arranged in a radiated ring) as well as separated, abounds on the *surface* of the type specimen (which was kindly given to me by Mr. E. Parfitt, of Exeter), but *not in the interior*. It at once appeared to me that such a form of spicule could not belong to any species of *Spongilla*; and, indeed, I have never seen any thing identifiable with it either in the freshwater or marine sponges. Mr. Parfitt found the specimen, and sent part of it to Dr. Bowerbank, who immediately seized upon it as a new species of *Spongilla*.

5. *Meyenia Capewelli*.

Spongilla Capewelli, Bk., No. 20, p. 9, pl. xxxviii. fig. 3.

Massive, sessile. Surface even, lobular. Structure friable, crumbling. Skeleton-spicule curved, fusiform, abruptly sharp-pointed, smooth, sometimes inflated in the centre. Statoblast globular; aperture infundibular; crust thick, composed of granular microcell-substance charged with birotulate spicules consisting of a straight shaft somewhat inflated in the centre, terminated at each end by an umbonate disk of equal size, whose margin is irregularly crenulo-denticulate, and whose surface is granulated towards the circumference often in lines running towards the centre, mixed with faint radiating lines generally coming from that point, arranged perpendicularly, with one disk resting on the chitinous coat and the other forming part of the surface of the statoblast.

Loc. Lake Hindmarsh, Victoria, Australia, lat. 35° 30′ S., long. 141° 40′ E.

6. *Meyenia plumosa.* (Pl. V. fig. 6, *a-k.*)

Spongilla plumosa, Carter, No. 12, p. 85; No. 20, p. 11, pl. xxxviii fig. 5.

Massive, lobate. Structure feathery, fibrous, friable. Colour greenish or light brown. Skeleton-spicule curved, fusiform, gradually sharp-pointed, smooth. Flesh-spicule stelliform, consisting of a variable number of arms of various lengths radiating from a large, smooth, globular body; arms spined throughout; spines longest at the ends, so as to present a capitate appearance, and recurved generally (fig. 6, *k*); the whole varying from a simple, spinous, linear spicule to the stellate form first mentioned, thus modified by the size and presence of the globular inflation and number of arms developed from the centre of the former; abundant in all parts of the structure, but especially in the neighbourhood of the statoblasts. Statoblast ellipsoidal (fig. 6); aperture lateral, infundibular (fig. 6, *f*); crust, which is thick and composed of granular microcell-substance (fig. 6, *d*), charged with birotulate spicules (fig. 6, *e*) consisting of a long, straight, sparsely spiniferous shaft whose spines are large, conical, and perpendicular, terminated at each end by an umbonate disk of equal size, whose margin is irregularly denticulated, with the processes more or less turned inwards (fig. 6, *h*, *i*), arranged perpendicularly, with one disk resting on the chitinous coat and the other forming part of the surface of the crust (fig. 6, *e*).

Loc. Bombay.

Obs. The variety in the minute spiculation generally of this species renders it perhaps the most beautiful in this respect that has yet been discovered.

7. *Meyenia Baileyi.*

Spongilla Baileyi, Bk., No. 20, p. 13, pl. xxxviii. fig. 6.

Coating, surface smooth. Structure friable, crumbling. Skeleton-spicule curved, subfusiform, gradually sharp-pointed, smooth. Flesh-spicule minute, curved, fusiform, gradually sharp-pointed, covered with erect obtuse spines throughout, extremely small towards the extremities, and extremely long and perpendicular about the centre of the shaft. Statoblast globular; aperture infundibular; crust, which is thick and composed of granular cell-substance, charged with birotulate spicules consisting of a long, straight, sparsely spiniferous shaft whose spines are large, irregular in length, conical and perpendicular, terminated at each end by an umbonate disk of equal size deeply but regularly denticulated, whose processes are claw-like and turned inwards, arranged perpendicularly, with one disk resting on the chitinous coat and the other forming part of the surface of the statoblast.

Loc. New York. In a stream on the Canterbury Road, West Point.

Obs. This seems to be the North-American representative of the Bombay species, viz. *Meyenia plumosa*, but with globular, not elliptical, statoblast.

8. *Meyenia anonyma*, Carter, n. sp.
(Pl. VI. fig. 12, *a–f.*)

Sponge unknown. Statoblast flask-shaped (fig. 12); aperture terminal (fig. 12, *c*); composed of a membranous coat striated longitudinally (fig. 12, *a*), supporting a reticulation (fig. 12, *b*) consisting of extremely minute, erect, conical processes with their sharp ends inwards, and presenting in the centre of each interstice, especially towards the fundus, a short, thick, somewhat hourglass-shaped spicule whose outer end is more or less denticulated, and whose inner one is inserted into the striated coat (fig. 12, *d*, *e*). Investing membrane of the germinal matter transparent, presenting the usual polygonal reticulation without granules, like compressed cell-structure (fig. 12, *f*).

Loc. River Amazons.

Obs. Of this statoblast, which is indicative of an undescribed species of *Spongilla*, I can state nothing more than that its presence appeared to me to be an accidental occurrence on the surface of another species which had grown over the surface of a leaf sent to me by Dr. Dickie.

TUBELLA*.

Gen. char. Skeleton-spicule curved, fusiform, sharp-pointed or rounded at the extremities, smooth or spined. Statoblast globular or elliptical; aperture lateral or terminal; crust composed of the granular microcell-substance mentioned, charged with inæquibirotulate spicules—that is, a little trumpet-shaped spicule having a straight shaft which is smooth, spined or inflated, or both, terminated by a large disk at one, and a small one or an umbonous, circular, marginally spined head at the other end (Pl. V. fig. 7, *i*); the former applied to the chitinous coat, and the latter forming part of the surface of the statoblast.

1. *Tubella paulula.* (Pl. VI. fig. 10, *a–c.*)

Spongilla paulula, Bk., No. 20, p. 15, pl. xxxviii. fig. 8.

Thin, incrusting. Surface even. Structure fragile, crumbling. Colour now brown. Skeleton-spicule curved, fusiform, abruptly sharp-pointed, spiniferous or smooth. Statoblast globular; aperture sunken, infundibular; crust composed of granular microcell-structure charged with two kinds of inæquibirotulates, one form of which is much stouter than the other, and consists of a straight shaft passing by trumpet-like expansion into the large disk, which often has radiating lines, and abruptly terminating in the other, which is only one fourth of the diameter of the former (Pl. VI. fig. 10, *a*, *b*); the other form similarly constructed, but more delicate, with the shaft inflated towards the large disk, and the smaller one much less in proportion than in the larger form (fig. 10, *c*); the forms not mixed but confined to their statoblasts respectively; arranged perpendicularly, with the large disk resting on the chitinous coat, and the smaller one forming part of the surface of the statoblast.

Obs. Although the skeleton-spicule in Dr. Bowerbank's illustration is smooth, it is stated in his diagnosis (p. 16, *l. c.*) to be "entirely spined," which is the case generally, but not always; so that the artist must have taken for the illustration one of the smooth ones.

2. *Tubella spinata*, Carter, n. sp.
(Pl. VI. fig. 9, *a–m.*)

Thin, coating, spreading. Structure fragile, crumbling. Colour light brown. Skeleton-spicule curved, fusiform, gradually sharp-pointed, smooth or spiniferous. Flesh-spicule minute, curved, fusiform, thin, gradually sharp-pointed, covered with perpendicular spines, which are longest about the centre (fig. 9, *m*). Statoblast elliptical, flask-shaped; aperture terminal (fig. 9, *f*); crust thick, composed of granular microcell-substance (fig. 9, *d*) charged with inæquibirotulate spicules (fig. 9, *e*) consisting of a straight shaft, inflated near the small end, and passing by trumpet-like expansion into the large disk, sparsely spined (fig. 9, *h*); disk circular, smooth, with even margin (fig. 9, *i*), small end consisting of a circular convex head, regularly denticulated on the margin with eight or more conical processes, which are slightly inclined towards the shaft (fig. 9, *k*, *l*); arranged perpendicularly, so that the disk rests on the chitinous coat and the head forms part of the surface of the statoblast (fig. 9, *e*).

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* *Tubella*, a little *straight* trumpet.

Loc. River Amazons. On a leaf sent to me by Dr. Dickie in 1878.

3. *Tubella reticulata.* (Pl. VI. fig. 8 *a*–*n*, and fig. 16.)

Spongilla reticulata, Bk., No. 20, p. 17, pl. xxxviii. fig. 9.

Elliptical, or fusiform when growing round the immersed small branches of trees. Structure *extremely rigid*, reticulate, terminating in thorn-like processes on the surface. Colour light sea-green when growing in clear water. Skeleton-spicules curved or bent, cylindrical or subfusiform, rounded at the ends, absolutely smooth or sparsely spiniferous (Pl. VI. fig. 8, *m*, and fig. 16), becoming more so towards the statoblasts, where they are not more than half the size, thickly spined, and in this shape form a distinct capsular layer around each of those organs (fig. 8, *l*, *n*). Statoblast elliptical, ovoid (fig. 8); aperture terminal (fig. 8, *f*); crust composed of granular microcell-substance (fig. 8, *d*) charged with inæquibirotulate spicules (fig. 8, *e*) consisting of a straight shaft passing by trumpet-like expansion into the large disk, with two or more spines about the centre, and furnished with a ring-like inflation towards the disk (fig. 8, *h*); disk circular, smooth, with even margin, which is somewhat recurved (fig. 8, *i*), small end consisting of a circular umbonate head regularly denticulated on the margin with 6–8 conical processes, which are slightly inclined inwards or towards the shaft (fig. 8, *k*); arranged perpendicularly, so that the disk rests on the chitinous coat, and the head or small end forms part of the surface of the statoblast (fig. 8, *e*).

Loc. River Amazons.

Obs. The skeletal structure of this species, although of the same rigid nature and general character as that of *Parmula Batesii* and *P. Brownii*, to be hereafter mentioned, is more reticulated and not nearly so coarse as in the latter.

4. *Tubella recurvata.* (Pl. V. fig. 7, *a–l.*)

Spongilla recurvata, Bk., No. 20, p. 18, pl. xxxviii. fig. 10.

Sessile, coating. Surface even. Structure fragile, crumbling. Colour brownish. Skeleton-spicule curved, fusiform, abruptly sharp-pointed, smooth or spiniferous. Statoblast globular (Pl. V. fig. 7); aperture infundibular (fig. 7, *g*); crust thick, composed of granular microcell-substance (fig. 7, *d*), charged with inæquibirotulate spicules (fig. 7, *e*) consisting of a delicate, straight, smooth shaft passing by trumpet-like expansion into the large disk, which is circular, smooth, saucer-shaped, inverted, with even margin, curved towards the shaft, and abruptly terminating in the other, which is only one eighth of the diameter of the disk (fig. 7, *i*), arranged perpendicularly with the large disk resting on the chitinous coat, and the small one somewhat *within* the surface of the crust (fig. 7, *e*); surrounded by a capsule of short thick spicules (fig. 7, *f*), consisting of a straight smooth shaft, slightly inflated in the centre, and terminated at each end by an equal-sized head, which is prominently umbonate, with circular margin regularly divided into eight conical teeth slightly incurved (fig. 7, *k*, *l*), arranged perpendicularly around the statoblast, with one end free and the other adherent to the surface of the crust (fig. 7, *f*).

Loc. River Amazons.

Obs. This kind of capsular covering is, so far, unique, and renders the whole structure of the statoblast as remarkable as it is beautiful under microscopic observation.

PARMULA*.

Gen. char. Globular or elliptical, fusiform when growing round the small immersed branches of trees. Structure coarsely reticulate, extremely hard and rigid, rising into thorn-like processes on the surface. Colour light green. Skeleton-spicule acerate, curved, fusiform, abruptly sharp-pointed, smooth. Statoblast globular, large, more or less tubercular on the surface; aperture infundibular; crust composed of granular microcell-substance (Pl. V. fig. 2, *a*), charged with and surrounded by minute, spinous, acerate spicules (fig. 1, *g*, and 2, *d*), limited by a layer of parmuliform spicules (fig. 2, *b*, *c*) both internally and externally, the former in contact with the chitinous coat (fig. 1, *e*), and the latter on the surface of the crust† (fig. 1, *f*).

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* *Parmula*, a little round shield.

† As these characters are taken from the only species yet known, they may hereafter have to undergo alteration.

1. *Parmula Batesii.*

(Pl. V. fig. 1, *a–i*, and fig. 2, *a–c*, also Pl. VI. fig. 15.)

Spongilla Batesii, Bk., No. 20, p. 21, pl. xxxviii. fig. 12.

More or less globular when growing round the small immersed branches of trees one inch or more in thickness. Structure coarsely reticulate, extremely hard and rigid, rising into thorn-like processes on the surface. Colour light sea-green. Skeleton-spicule curved, fusiform, abruptly sharp-pointed, smooth (Pl. VI. fig. 15), forming, when bundled together with the hard transparent sarcode, the rigid structure above mentioned, charged throughout with statoblasts. Statoblast large, globular, more or less uniformly tuberculated (Pl. V. fig. 1). Aperture infundibular (fig. 1, *h*). Crust very thick, composed of granular microcell-structure of a white colour, which, growing out through the interstices of the reticular arrangement of skeleton-spicules, reduced in size, which form a capsular covering to the statoblast, gives it the tuberculated character mentioned (fig. 1, *d*), charged with and surrounded by minute, thin, curved, fusiform, gradually sharp-pointed, spinous acerates irregularly dispersed throughout its substance (fig. 1, *g*, and 2, *d*), limited, both inside and outside, by a layer of parmuliform spicules, the former in contact with the chitinous coat (fig. 1, *e*), and the latter on the free surface of the crust, giving it a light brown colour (fig. 1, *f*). Parmuliform spicule circular, flat, infundibuliform, terminating in a point, like a little round shield turned up at the margin, which is even (fig. 2, *b*, *c*), arranged both internally and externally in juxtaposition, more or less overlapping each other, with the funnel-shaped process *outwards* in both instances, so that the surface of the crust is covered with little points (fig. 1, *f*).

Loc. River Amazons.

Obs. The double layer of statoblast-spicules, viz. one on the inner and the other on the outer side of the crust, is seen also in *Spongilla nitens*.

2. *Parmula Brownii.*

Spongilla Brownii, Bk., No. 20, p. 19, pl. xxxviii. fig. 11.

Globular, four or more inches in diameter, appended to a small twig rather than embracing it. Structure and colour the same as in the foregoing species. Skeleton-spicules the same, but diminished to half their size round the statoblasts, to which they afford a distinct capsule. Statoblast globular; aperture slightly infundibular; crust thin, composed of microscopically minute spherical cells, irregularly agglomerated together, so as to produce small lacinuliform processes, which project into the interspaces between the capsular spicules; unaccompanied by the spinous spicule, which is present in the foregoing species, and without a continuous layer of the parmuliform spicule over the surface, but presenting one in contact with the chitinous coat, where it is overlain by an extremely thin development of the microcellular crust, from which the lacinuliform processes above mentioned are projected.

Loc. British Guiana (*Schomburgk*). British Museum, general collection. Running no. 527.

Obs. The most remarkable part about this species is the cell-structure of the crust, which is just a transition in size from that of *Spongilla Carteri* and *S. nitens* to the minute granular form of *Parmula Batesii* &c., thus showing that the latter is also composed of minute cells, which, as before stated, require a power of 450 diameters to be resolved. Thus with *Tubella reticulata* and *Parmula Batesii* we possess three of those species with extremely rigid reticulated structure which as yet have only been found in the river Amazons, but to which the provisional genus "*Uruguaya*," as will presently be seen, also appears to be allied.

URUGUAYA, n. gen. prov.

1. *Uruguaya corallioides.* (Pl. VI. fig. 17.)

Spongilla corallioides, Bk., No. 20, p. 22, pl. xxxviii. fig. 13.

Irregularly digitate; rising into a polychotomous and anastomosing mass of cylindrical branches, which may attain several inches (7 or more) in all directions. Colour faint whitish yellow or dark leaden on the surface, internally white or colourless. Surface even, vitreous in appearance, extremely hard, smooth, and compact, interrupted by small raised vents more or less uniformly distributed at short and unequal distances from each other. Internal structure composed of short densely reticulated fibre, formed of the skeleton-spicules of the sponge in bundles firmly united together by colourless sarcode, which, together with the spicules, in a dried state simulates, from its hardness and vitreous appearance, an *entirely* silicified mass. Skeleton-spicule very robust, much curved, cylindrical, rounded at both ends, smooth or microspined, about six times longer than it is broad (Pl. VI. fig. 17). Statoblast unknown.

Loc. "Rapids" of the river Uruguay, above the town of Salto, Uruguay.

Obs. This is a most interesting species in almost every particular. 1st. Some of the specimens of it that have been sent to England are very large. 2nd. That sent by Mr. George Higgin to his brother, Mr. Thomas H. Higgin, F.L.S., of Liverpool, the former took from the "rapids" of the river Uruguay, above the town of Salto, "200 or 300 miles" from the sea in the delta of the Parana; in which "rapids" the amount of water is subject to such great alteration in quantity that, when Mr. Higgin found it, the stream was confined to the "cracks in the rock," while when he returned to the spot again it was "40 feet deep." The specimen sent to Liverpool is still adherent to the piece of rock on which it grew; and all the other specimens of the sponge that Mr. Higgin saw at this spot were of the same kind. 3rd. In none of the specimens sent to England has the statoblast been seen, or any other trace of reproductive organs, although the size of the specimens evidences full growth, and the circumstances connected with them, viz. their presence in a river subject to great alteration in the size of the stream, and at a great distance from salt water, supply all that is required for a genuine freshwater sponge. 4th. The characters of the sponge above given are unique, although the hardness and rigidity of the skeletal structure seems to find a kinship with that of *Tubella reticulata* and *Parmula Batesii* &c., from the river Amazons, as before intimated, if not also with *Spongilla nitens*, whose locality is at present unknown.

With reference to the "leaden" colour of the surface, it is worthy of remark that this is not only confined to the surface, fading off into the white structure of the interior a little below it, but in the *same* branch may abruptly meet the faint whitish-yellow colour which the whole sponge may present on other occasions. The cause of this diversity in colour must be explained by future observation.

Of the specimens of this sponge known to me, one is in the Museum of the Royal College of Surgeons, which Dr. Bowerbank states is labelled "near Salto Grande, above Paysandu," presented by Mr. W. Bragge (No. 20, p. 23); but when Dr. Bowerbank adds that this place is on a tributary of the upper part of the river Amazons, it is evidently a mistake; for Salto and Paysandu are on the river Uruguay. Another specimen is in the British Museum, labelled "Freshwater sponge from Paraguay. Presented by R. McAndrew. Register no. 72. 11. 13. 1; running no. 622." A third is in the Liverpool Free Museum, viz. that sent to his brother by Mr. George Higgin, to which I have alluded; and a fourth is part of a specimen sent by Dr. Garland of Dublin to the same museum, which differs from all the rest in being of a faint yellow-white colour *throughout*, with an accumulation of minute brown bodies here and there on the surface towards the base, which are the capsules of one or two undescribed species of the verticellate infusorian "*Freia*," that cannot be confounded with the statoblasts (for they would be large enough to be seen with the naked eye, and situated in the interior).

Fulfilling all the other characters of a freshwater sponge, I cannot help thinking that a specimen will be found sooner or later in which the presence of the statoblast will complete them. At the same time, if we are right in identifying the statoblast with the winter-egg of the freshwater Polyzoon, that flustraceous Indian species which I have long since described and illustrated under the name of *Hislopia lacustris* ('Annals,' 1858, vol. i. p. 169, pl. vii.) has not, to my knowledge, been found to possess them; so it is not impossible that this may be the case with *Uruguaya corallioides*, of which I therefore make "provisionally" a new genus. The specimens mentioned have been carefully examined by different people over and over again; but in no instance has a trace of a statoblast been found, with the exception of that noticed by Dr. Bowerbank (No. 20, p. 23), which, I think, admits of much doubt, not so much of the existence of the "fragment" as of its belonging to *Uruguaya corallioides*.

Observations.

Although my classification is chiefly based upon the form of the spicules of the statoblast, yet it is not to be assumed that I have included all the species of the Spongillina that have been discovered, but those only in which this means of classification has been obtained, as will be seen by the following short summary of Dr. W. Dybowski's elaborate account of freshwater sponges from Lake Baikal, in Central Asia (No. 32).

The specimens were obtained by his brother Dr. Benedict Dybowski and Herr W. Godleuski while in Siberia, and have been divided into four species, with their varieties respectively, under the generic name of "*Lubomirskia*," after Prince Wladislau Lubomirski, thus—*L. baicalensis*, Pallas, sp., *L. bacillifera*, n. sp., *L. papyracea*, n. sp., and *L. intermedia*, n. sp.; in all of which the statoblast (gemmula) was absent; so that, whatever arrangement is made of them hereafter, the present one must rest upon their general form and that of their skeleton-spicule respectively, which places them much in the same position as the two original species (viz. *S. fluviatilis* and *S. lacustris*) before the spicules of their statoblasts were discovered.

Lubomirskia baicalensis.

Lubomirskia baicalensis, Pallas (apud Dybowski, No. 32, p. 11, Taf. i. fig. 1), with four varieties, viz. *a*, *β*, *γ*, *δ*.

One learns from the figure of this species (*op. cit.* Taf. i. fig. 1), which is half the natural size, that it consisted of long digital processes, about 14 inches by ½ an inch in their greatest diameters, more or less uniformly inflated at short intervals (that is, bullate), but solid throughout. Structure elastic, but not crumbling between the fingers. Colour dark grey or olive-green. Skeleton-spicule curved, fusiform, gradually sharp-pointed, spiniferous generally, but especially towards the ends, particularly in the variety *γ*, where the rest of the shaft is smooth (Pl. VI. fig. 19).

Loc. Lake Baikal.

Largest skeleton-spicule 0·222 by 0·021 millim. "Parenchyma-spicule" (? early form of the foregoing) 0·159 by 0·006 millim., a smooth thin accrate (fig. 19, *a*).

Lubomirskia bacillifera.

Lubomirskia bacillifera, n. sp. (No. 32, p. 22, Taf. i. figs. 2, 4, 5, and 6, &c.), with three varieties, viz. *a*, *β*, *γ*.

Massive, more or less lobed. Structure much the same as that of the foregoing species, but finer and softer. Colour grass-green. Skeleton-spicule curved, cylindrical, sometimes fusiform (as in the variety *β*), round at the ends, and spiniferous generally, but more particularly over the ends, sometimes (as in the varieties) smooth over the rest or middle of the shaft (Pl. VI. fig. 20).

Loc. Lake Baikal.

Largest skeleton-spicule 0·270 by 0·024 millim. Parenchyma-spicule a small, thin, smooth acerate. No measurement.

Lubomirskia intermedia.

Lubomirskia intermedia, n. sp. (No. 32, p. 28, Taf. iv. fig. 3, A, spicule only), with one variety, viz. *a*.

Flat, spreading. Structure like that of *L. baicalensis*, but more tender. Colour yellowish or olive-green. Skeleton-spicule curved, fusiform, gradually sharp-pointed, spiniferous generally (Pl. VI. fig. 21).

Loc. Lake Baikal.

Largest skeleton-spicule 0·222 by 0·018 millim. Parenchyma-spicule a large smooth acerate. No measurement given.

Lubomirskia papyracea.

Lubomirskia papyracea, n. sp. (No. 32, p. 33, taf. i. fig. 7 &c.).

Papyraceous in thinness, with smooth shining surface. Structure very soft. Colour white. Skeleton-spicule thick (seven times longer than broad), curved, cylindrical, round at the ends, thickly spiniferous throughout (Pl. VI. fig. 22).

Loc. Lake Baikal.

Largest skeleton-spicule 0·144 by 0·018 millim. Parenchyma-spicule a very small smooth acerate.

Obs. The "parenchyma-spicule" appears to be the same in each of these species, and therefore is probably merely an early form of the skeleton-spicule, and not a "flesh-spicule," which it is hardly to be supposed would be the same in all four.

Observations.

Besides the new species of freshwater sponges in Lake Baikal, Dr. Dybowski mentions the occurrence of *Spongilla lacustris* in a small lake at its western end, called the "Pachabicha See," together with a new species, viz. *S. sibirica* (No. 32, p. 66), which is not described; also the occurrence of *Spongilla lacustris* in the Goktscha See in Transcaucasia, in the Dnieper, Minsk, Livonia, and about Warsaw and Charkow; also *Ephydatia* (*Spongilla*) *fluviatilis* in Livonia, Warsaw, and Charkow; besides *Trachyspongilla erinaceus* (No. 28 and No. 32, Taf. 4. fig. 13 *a*), *Spongilla erinaceus* (No. 32, p. 33), ? *Spongilla erinaceus*, Ehr.

Thus it is evident from what has been above stated that freshwater sponges have been found in many parts of Europe, in Asia, and in the two Americas; but, to my knowledge, no notice has been made public of their occurrence in Africa; still it may be fairly inferred that new species will be discovered there as well as elsewhere; and a yet further inference may be drawn, viz. that we are only on the threshold of our knowledge of the extent and varieties of the Potamospongida generally, so vast are the freshwater areas that have not been explored for this purpose.

Ehrenberg in his 'Mikrogeologie,' 1855, Taf. 1–12, represents many amphidisks (birotulates) which he found in "freshwater deposits" of various parts of the world, several of which are quite different in form from those with which we are acquainted.

Lastly, I would observe that, although I have endeavoured to make the above communication immediately useful, it is by no means intended to supply what can only be obtained by a careful perusal at leisure of all that has been written on the subject, especially that to which I have referred.

EXPLANATION OF THE PLATES.

N.B.—1. All the figures of the statoblasts are drawn to the same scale, viz. 1-24th to 1-1800th inch, in order that their constituent parts may appear under the same magnifying-power. They, however, are to a certain extent diagrammatic for the sake of clearness, inasmuch as all the coats are of course *in contact* naturally; the chitinous coat, which is represented by the *dark* line, is not quite so thick and the spicules are not quite so scanty as they are represented; but, generally speaking, the whole may be considered *relatively* magnified on the scale above mentioned.

2. All the "more magnified" parts or spicules are drawn to the scale of 1-12th to 1-6000th inch.

3. The skeleton-spicules, viz. figs. 14-18, are drawn to the scale of 1-12th to 1-1800th inch, and the rest, viz. 10-22, on much the same scale, having been traced off those done with Hartnack's no. 4, prism and objective (No. 32, p. 69).

4. Fig. 13, *f*, is only magnified three diameters.

5. It should be remembered that all sponge-measurements, both general and elementary, can only be considered approximative; for what is fixed upon as a standard at one time may be upset by the measurements of another, chiefly on account of the objects appearing under different degrees of development in different specimens. Still there is an average largest size and shape of the spicule which can easily be recognized: but this too is subject to differences; for it may be thick or thin, although *fully developed*, while the former is the shortest and the latter the longest. Thus varieties are numerous; but the great point is to give the average shape and size of the fully-developed object, and to avoid as much as possible the variations; for the latter confuse, while a very slight acquaintance with sponge-structure points out that their existence may be inferred in all cases.

Plate V.

Fig. 1. *Parmula Batesii.* Perpendicular section of the statoblast through the aperture, showing:—*a*, cavity filled with germinal matter; *b*, coat enclosing the same; *c*, chitinous coat; *d*, crust; *e*, internal layer of parmuliform spicules; *f*, external layer of the same; *g*, minute spinous acerate spicules; *h*, aperture; *i*, nipple-like prolongation of *b*.

Fig. 2. The same. More magnified view of fragment of crust bearing two parmuliform spicules: *a*, crust, to show granular appearance of microcellular structure; *b*, parmuliform spicule, end view; *c*, the same, lateral view; *d*, more magnified view of spinous acerate spicule.

Fig. 3. *Spongilla nitens*, n. sp. Perpendicular section of the statoblast through the aperture: *a*, cavity filled with germinal matter; *b*, coat enclosing the same; *c*, chitinous coat; *d*, crust composed of columns of hexagonal cells in the section, in juxtaposition; *e*, inner layer of spinous acerates; *f*, external layer of the same; *g*, aperture; *h*, nipple-like prolongation of *b*; *i*, more magnified view of cell-structure of crust; *k*, the same of spinous acerate.

Fig. 4. *S. navicella*, n. sp. Perpendicular section of the statoblast through the aperture: *a*, cavity filled with germinal matter; *b*, coat enclosing the same; *c*, chitinous coat; *d*, layer or capsule composed of minute navicelliform acerates (no appearance of crust-substance); *e*, aperture; *f*, nipple-like prolongation of *b*; *g*, more magnified view of navicelliform spicule.

Dussumieri) as the young of species which retain the spinous character of the scales all their lives; for they may just as well belong to species which, like *B. Raji*, become completely smooth as they advance in age. The small *Bramæ* with spines, from 11–47 millims. long, that I have examined, which in general agree with the young forms above mentioned and formerly described, present no peculiarity which prevents our referring them to *B. Raji*; and consequently we may very well provisionally range these nominal species among the synonyms of the type species in question. It is probable, however, that the young individuals belonging to the different species of *Brama* will closely resemble one another, and be extremely difficult to distinguish; in those which I have at my disposal, some of which (the largest) were found in the stomach of large voracious fishes, and others (the smaller ones) fished at the surface of the Atlantic, I have been able to recognize only the elements of a single continuous series, and not the representatives of several species. One of the oldest and one of the youngest individuals of this series referred to *B. Raji* are represented in pl. iv. (of the Danish memoir); and I refer the reader for their differences and for their comparison with the adult fish to figs. 1 and 2.

With the young *Bramæ* which we have just been discussing there was also a *Pterycombus*, perhaps a young *P. brama*, an arctic species inhabiting deep water, hitherto known only from specimens derived from the coasts of Finmark and Norway; this specific determination, if correct, will furnish a fresh proof of the conformity presented in general by the faunas of great depths in the tropical and arctic seas. In the stomach of the same albacore which contained these interesting young Bramidæ there was also a young fish belonging to the arctic genus *Himantolophus*, perhaps *H. Reinhardti*. Fig. 4, pl. iv. (of the Danish memoir), placed near that of the adult *Brama*, will elucidate the very considerable changes that the young *Pterycombi* undergo during their growth and development.

A pelagic genus allied to *Brama* and *Pterycombus* is the genus *Pteraclis*, the still little-known species of which perhaps need to undergo some reduction. Our sailors have found it in the stomachs of albacores; and they have moreov captured in the nets very small examples of 7–15 millims. long. Their physiognomy greatly resembles that of the youn *Bramæ* and *Pterycombi*; and they differ as much as these ar the young dorados from fully developed fish. The body is short, thick, and pyriform; the scales are high and hexagonal, each armed with a spine directed backward; the præoperculum is very spinous; the dorsal and anal are low and almost completely retractile within their scaly sheaths; as in the young *Coryphænæ* and *Pterycombi*, the dorsal does not commence so far forward as at a later period, and it is placed further back in proportion as the fish is younger; the ventrals are composed of a few very fine rays &c.

9. NAUCRATES, NAUCLERUS, and XYSTROPHORUS; NOMEUS, PORTHMEUS, LICHIA, and CHORINEMUS; PAROPSIS.

Mr. Gill and myself, some years ago, showed that the *Naucleri* are young forms of *Naucrates*; and the synonyms of the celebrated pilotfish (*N. ductor*) have consequently been augmented by the other probably merely nominal species of *Naucrates*, by all those of the genus *Nauclerus*, and by two species referred to the genus *Seriola*. But it has not hitherto been noticed that *Xystrophorus*, Rich., is nothing but the youngest form of *Naucrates*; moreover, among the first stages of *Seriola* there are also some which present, in part, the characters of *Xystrophorus*. The very young *Naucrates* are among the small fishes which are often met with among the arms, tentacles, &c. of the *Physaliæ*, pretty frequently associated with *Nomeus Gronovii*, which is not less pelagic than *Naucrates*. These little fishes, as well as the young of *Seriola*, *Coryphæna*, &c., are also met with in the floating masses of seaweeds. The young of *Naucrates* and *Nomeus* constitute the most frequent product of net-fishing in the open sea; and we thus possess numerous examples of them, which bear witness in favour of their wide geographical distribution. In *Nomeus* the changes arising from age and development are comparatively insignificant, but, perhaps, only because they occur so early that they have not hitherto attracted attention.

Porthmeus argenteus, of which our museum possesses an example 74 millims. long, from the coast of Guinea, is not, as has been supposed, a young form of *Chorinemus*, but of *Lichia amia*. As this species must be referred to a different genus from *Lichia glaucus*, we may very well leave to the latter the name of *Lichia*, and in future designate *L. amia* under that of *Porthmeus amia* (Lac.). On the other hand, *Lichia calcar*, Bl., of which I have before me a specimen 25 millims. long, is a young form of some *Chorinemus* of the Atlantic with four dorsal spines, perhaps *Chorinemus saliens*. The museum has received a corresponding series of a *Chorinemus* from the Indian Ocean 25–34 millims. long, with seven spinous dorsal rays, including successive stages up to the perfectly developed although still very young form. For the subdivision of this genus it would be best to employ a difference hitherto unnoticed (see the fig. on p. 512 of the Danish memoir), namely the existence or absence of teeth on the pterygoids side by side with those of the palatines and vomer, in accordance with the following scheme, the divisions of which must, however, only be estimated as sections or subgenera, and not as true genera:—

A. 4–5 (6) dorsal spines; scales linear; no teeth on the pterygoids. *C occidentalis*, *saliens*, *palometa* (*Oligoplites*, Gill).

B. 7 dorsal spines, and teeth on the pterygoids.

1. Scales linear: *C. tol* (*C. moadetta*, Klz., perhaps the young form of *C. tol*).
2. Scales short and broad: *C. lyson*, *sancti Petri*, and a new species from Singapore which greatly resembles *C. altus* of the western coast of Central America.

In some species the teeth of the upper jaw are uniserial, and in others bi- or pluriserial; but those of the mandible are always biserial, although here a remarkable difference due to age makes its appearance; the older individuals are *homodont*, and the young *heterodont*. In other words, in the young *Chorinemi*, until they are about half-grown, the outer row in the mandible consists of very small, numerous, setiform teeth placed very close together (almost as in the Chætodonts), which are very different from the strong, conical, recurved teeth, separated by distinct intervals, and consequently much less numerous, of the inner row. During the growth of the fish these outer teeth are replaced by a new row of teeth, which, according to the species, are identical with, or more or less similar to those of the inner row. A somewhat superficial observation of these important modifications of the dental system, which depend upon the age of the individual, might easily lead to the establishment of unfounded specific distinctions. The pterygoidian teeth, mentioned above, likewise exist in the genus *Paropsis*; and this genus presents another peculiarity not previously mentioned, namely the ramification of the lateral line, which, however, seems to become less marked with increasing age.

10. PSENES, CUBICEPS, and NAVARCHUS.

It is already known that *Navarchus* is generically identical with *Atimostoma* and *Trachelocirrus*, as also that this genus falls into that of *Cubiceps*. But in the present state of science it is equally difficult to separate the genera *Psenes* and *Cubiceps*. Under these two names a series of species have been described which are for the most part young forms still unknown in the adult state, and which will no doubt have to undergo reduction. Among the rather numerous small pelagic individuals of the genus *Psenes* possessed by our museum, I have been able to distinguish five or six species; but I have only partially succeeded in referring them to those which have been described. I regard as new a high, short, and very compressed form, nearly colourless and semitransparent, from the Straits of Surabaya, *P. pellucidus*, sp. n. (figured p. 516 of the Danish memoir), which, I suppose, could not very well represent the juvenile form of a *Navarchus*. Another form very widely distributed in the Atlantic is represented in pl. v. fig. 2 (of the Danish memoir); I have made it provisionally a new species under the name of *P. maculatus*, but strongly suspect that it may be a young form of *Navarchus sulcatus* (*Cubiceps gracilis*), or of *Atimostoma capense* (species which are perhaps identical), or of some analogous form. We shall hardly deceive ourselves if we regard these three types (*P. maculatus*, *N. sulcatus*, and *A. capense*) as three successive stages of a single species, or, at any rate, of several very nearly allied species, which only appear rarely at the surface of the sea in their developed state, and which, in consequence, are still but little known to naturalists; perhaps, indeed, it is not precisely my *Psenes maculatus*, but another nearly allied form, which I have met with more rarely, and which is distinguished by a smaller number of rays in the vertical fins, that is really the young form of *Navarchus sulcatus* and *Atimostoma capense*. The group *Psenes-Cubiceps* is, in point of fact, one of the pelagic groups of which we know least, and with regard to which we have scarcely begun to lift a little corner of the veil which hides the rich ichthyological fauna of the great depths. In none of these young or more advanced forms of *Psenes* have I found a spinous præoperculum as in so many other young Scomberoids, and as is the case in the adult state with the præoperculum and interoperculum of a fish which appears to be very nearly related to *Psenes*, namely *Palinurichthys* (*Pammelas*) *perciformis*; there is nothing which seems to indicate that any of the forms of *Psenes* that have been described, or that I have examined, can be derived from that species, which is only known from specimens from the eastern coast of North America.

11. Stromateus, Apolectus; Schedophilus; Trachynotus; Micropteryx; Seriola.

The conjecture has already been put forward that the "*Rhombus crenulatus*," Cuv., is a young form of *Stromateus alepidotus* (*Gardenii*, *longipinnis*). Dr. Günther has also shown that *Stromateus securifer* is only a young *S. argenteus* (*candidus*); and the subordination on the same ground of *Apolectus stromateus* to *S. paru* is confirmed by the description of a little fish (13 millims.) from the Straits of Riouw, with large ventrals and the margin of the præoperculum denticulated, in which I have recognized a still younger form of the *Apolectus* and of *S. paru*. In consequence of these analogies, and depending in part upon the materials at my disposal, and in part on what I have found in the literature of the subject, it seems to me more than probable that *S.* (*Seserimus*) *microchirus*, with more or less rudimentary ventrals, is a young form of *S. fiatola*; but as this question, when once raised, may easily be elucidated by the ichthyologists of the Mediterranean coasts, I shall leave to them the task of solving it, and shall not discuss it further. With regard to the genus *Stromateus* I shall further remark that the separation effected by M. Bleeker of the three species *S. argenteus, cinerea*, and *sinensis* (*atous, albus*) as forming a distinct genus, *Stromateoides*, must be sustained. This genus is chiefly characterized by its short branchial clefts; young examples of *Stromateoides sinensis* also confirm the proposition, already advanced by M. Bleeker, that the ventrals, in this genus, disappear earlier than in the true *Stromatei*, if indeed they are not completely deficient. *S. medius*, Pet., is a true *Stromateus*, and not a *Stromateoides*.

The genus *Schedophilus*, which belongs to the true pelagic fishes, counts several (4) species; I shall abstain from discussing whether it may not be necessary to make them undergo some reduction. The pretty numerous specimens, chiefly young, that our Museum possesses must all be referred to *S. medusophagus*. The differences of age manifested in the proportions of the parts of the body, the system of coloration, &c. might certainly, if we examine them isolatedly, give rise to the establishment of illegitimate species; but they have no great importance from a general point of view.

The great differences arising from age, which, in the genus *Trachynotus*, have caused a series of false species, and even genera (*Doliodon, Bathrolæmus*) to be established, have already been dealt with by MM. Günther and Gill, and I have nothing essential to add. I shall only remark that *T. rhomboides* of the West Indies already has its rhomboidal physiognomy and its much prolonged sickle-shaped fins at an age when these prolongations of the fins are still rather short in the *T. ovatus* of the Indian seas, and that I am of opinion (with Mr. Gill) that these two species must be regarded, at least provisionally, as distinct. On the other hand, *Micropteryx* (*Chloro-*

scombus) *chrysurus* is not one of the forms in which the changes due to age can give rise to the establishment of deceptive species. Nevertheless the scapular and præopercular spines, which are characteristic of so many Scomberoids in the first phases of their development, are not wanting in the youngest individuals (10–25 millims.) of the series that I have examined.

The division indicated by G. Cuvier, and effected by Mr. Gill, of the genus *Seriola* into two distinct genera, *Zonichthys*, Swainson, and *Halatractus*, Gill, seems to be very natural. (*S. gigas* is the type of a third genus, *Naucratopsis*, Gill; and *S. Dussumieri* and *succincta* are young forms of *Naucrates ductor*). To the genus *Zonichthys* belongs *S. nigrofasciata* (with which *S. intermedia* is no doubt to be united); the genus *Halatractus*, or *Seriola* proper, includes *S. Dumerilii*, Risso (with which I identify not only *S. purpurascens*, Schl., but also *S. Solandri*, C. & V.), *S. quinqueradiata*, Schl., *S. zonata*, Mitch. (*carolinensis*, Holbr.), and *S. rivoliana* (*S. Boscii*, *falcata*, and *bonariensis* perhaps do not differ from this last species). *S. tapeinometopon* (an example 73 millims. long from the Indian Ocean) is no doubt only a young form of *S. Dumerilii*, with the transverse bands which are characteristic of so large a number of young Scomberoids. Young *Seriolæ* are tolerably frequent in our pelagic collections; the entire group may therefore no doubt be regarded as subpelagic, and certain forms (such as *S. rivoliana*) as completely pelagic. Besides several more or less juvenile forms of *S. Dumerilii* and *S. rivoliana*, our museum possesses very young forms (19–26 millims.) with the head armed with very large spines, and greatly resembling the so-called *Xystrophorus* phase of *Naucrates*; I have referred them to *S. zonata* (*carolinensis*); lastly, young spinous forms of *S. nigrofasciata* and *S. quinqueradiata*, with regard to which I refer to the figures (pl. iv. figs. 7–11 of the Danish memoir) for the greater or less differences in physiognomy, the system of coloration &c. which distinguish them from the adults. I think also that we must refer to the subpelagic forms the *Seriolichthys bipinnulatus* (the præoperculum of which, notwithstanding what has been said, is not denticulated), as having been observed not only in the Indian Ocean, but also in the Mediterranean and the West Indies. The *Seriolellæ* having been identified with the *Neptomeni* by Dr. Günther, we must suppose that the armature of spines indicated in them likewise does not constitute a permanent character.

12. Caranx, Carangichthys; Gallichthys; Selene (Argyreiosus, Vomer).

In the *Caranx* group too many and too few genera have been established. Following the principles adopted by certain authors, we might establish still more of them; for several undescribed species represented in our museum must furnish types for new divisions; on the other hand, we cannot approve of suppressing them all. A critical revision allows us to retain the six following genera:—

1. *Trachurus*, Cuv. (Gthr.). The lateral line is cuirassed throughout its whole length. The species of this genus have erroneously been united into a single one; I am able to distinguish the following:—*T. Linnæi*, Malm, the form from the Northern seas, which, however, is also met with in the Mediterranean; *T. mediterraneus* (Steind.), which also probably occurs in the Northern seas, where, however, it is certainly rare; *T. Cuvieri*, Lowe (Madeira, West Indies, west coast of South America); *T. japonicus*, Blkr. (China, Australia). The relative proportions between the two parts of the lateral line, its more or less sudden or oblique inflexion, and the height of the plates in proportion to their breadth, furnish good specific characters.

2. *Megalaspis*, Blkr. With 8–9 finlets separated from the dorsal and anal.

3. *Decapterus*, Blkr. A single finlet (the last ray of the fin) separated from the dorsal and anal.

4. *Caranx*, Cuv. Lateral line incompletely cuirassed as in 2 and 3; no isolated finlets. *Carangichthys* is only a young *Caranx* with the præoperculum denticulated. This genus has been divided into a great number of subgenera, which it would be superfluous to enumerate, and which ought all to be sup-

5. *Gallichthys*, Cuv. Naked, or nearly scaleless; the first dorsal is rudimentary in young individuals, and altogether wanting in the adults. *Blepharis*, *Scyris*, *Hynnis*, &c. are founded upon differences arising from age, and must consequently be eliminated.

6. *Selene*, Lac. (*Vomer*, *Argyreiosus*, &c.).

The young of *Caranx* and *Trachurus*, down to a length of 10–14 millims. for the smallest, are often brought by the sailors, and we thus possess a great number of them; but it is not possible to determine their species with exactitude except when they occur in more complete series, which enable us to recognize the characters of the adult. In my memoir I indicate the differences arising from age that I have observed in certain species, especially from the West Indies; and these, considering the difficulty of distinguishing from each other the species belonging to these genera, merit some attention. The youngest individuals with no scales or lateral line, and with a spinous præoperculum, certainly do not present any character which enables us to decide whether they are *Trachuri* or *Caranges*. The species in which I have observed the greatest changes during growth and development is *C. armatus*; but they are already in great part well known, and I shall not here examine them in more detail. These changes are, however, very inferior to those observed in the *Gallichthyes*, which have been divided into more genera than there are species in reality, because the successive stages which recur in an analogous manner in the different species have been interpreted as constituting so many separate generic types—the result of which has naturally been that the diagnoses of the species have become as incorrect as possible, and that systematic confusion has attained its final limits. Each of the three or four existing species passes through a phase of *Blepharis* (*Gallichthys*), one of *Scyris*, and one of *Hynnis*. *Hynnis goreensis* is thus the adult form of *Gallichthys ægyptiacus* and of *Scyris alexandrinus*; the forms described by Poey under the names of *Scyris analis* and *Hynnis cubensis* correspond in the same way to *G.* (*Blepharis*) *crinitus*. The *Scyris* phase belonging to *G. ciliaris* has not been before described. It may be asked (but, owing to the want of sufficient materials, I cannot decide the question) whether *G. ciliaris* of the Indian Ocean differs specifically from the American *G. crinitus*. If these two forms, comparatively rare in the adult state, are, as I suppose, fishes which inhabit tolerably deep water, we can understand that the same species might occur in seas far distant from each other. The general rule which finds its expression in the changes of form produced in this genus may be summed up as follows:—Greater and greater elongation of the body, so that its original proportions are completely altered; reduction of the number of spinous rays in the dorsal and anal fins, as also of the filamentous prolongations of the ventrals, and, later on, likewise of those of the dorsal and anal.

Exactly similar changes occur in the genus *Selene*, Lac. (p. p.) (= *Argyreiosus*, *Vomer*, *Platysomus*); and in consequence "analogy" and "affinity" have been until very lately confounded in them as in *Gallichthys*; nay, more, after Dr. Günther had elucidated the filiation of the forms in the essential points, the justice of his views was contested, and the error again maintained with a certain emphasis.

Leaving out of consideration *Argyreiosus dorsalis*, with regard to which I will not attempt to decide whether it is a variety of *Selene setipinnis* or a distinct species, it seems to me evident, from all that I know in nature and from literature, that instead of four species there are only two on the east coast of America, namely *Selene* (*Argyreiosus*) *vomer*, Linn., and *S. setipinnis*, Mitch. (*Vomer Brownii*). I have illustrated by two series of figures (pp. 543 and 547 of the Danish memoir) the development of these two species and the changes they undergo with age. The young form of *S. setipinnis* has been described under the name of *Argyreiosus unimaculatus*; if consistency had been desired it might have been set up as a distinct genus; the very old form of the same species is *Platysomus micropteryx* of Swainson. *Argyreiosus vomer*, L., *Zeus rostratus* and *Argyreiosus capillaris* of Mitchill, *A. Spixii*, Cast., *triacanthus* and *Mauricei*, Sw., and *senegalensis*, Guich., are all one and the same species, *Selene vomer* (L.), which, in its complete development, is represented by the *Selene argentea*, Lac., described by Brevoort. The two species attain nearly the same size (2 feet), and follow a very parallel course in their evolution—with this reservation, however, that the successive stages present greater differences among themselves in *S. vomer* than in *S. setipinnis*, and that the principal changes are earlier accomplished in this latter species. As will be seen from the figures, the young forms of the two species have the body very short and thickset; the first dorsal and the ventrals are well developed, and have filamentous prolongations in *S. vomer*; with age the body extends more or less in length, and the ventrals as well as the first dorsal are reduced to a minimum, while the pectorals become elongated, and the first ray of the anal and that of the second dorsal acquire an enormous length, in *S. vomer*. Thus, in proportion as the form of the body is modified, the prolongations of the fins which in the young perform the office of instruments of movement or of balancement, are replaced in the adults by prolongations of the same nature, but developed elsewhere. Both species occur on the west coast of Africa, and they have also been met with on the west coast of America. I must, however, remark that the species from Nicaragua possessed by our museum, and which there represents *S. vomer*, is a distinct species (*S. Oerstedii*, m.), distinguished by a peculiar profile and by the number of its rays (D. 8 . 1 . 18 ; A. 1 . 15).

13. ZEUS; ZENOPSIS (LAMPRIS; MENE).

A critical comparison of the materials in the possession of our museum, in the form of fishes from St. Pierre, in the

Mediterranean, combined with the statements contained in literature, has led to a fresh examination of a question which has also been raised elsewhere—namely, whether *Zeus faber* and *Z. pungio* must really be considered distinct species, or only varieties with a more or less local character. It is clear that the differences which have been appealed to are not characters relating to sex or age; but at the same time it results, from the examination that I have made, that *Z. pungio* can, at the utmost and even with difficulty, be regarded only as a variety of *Z. faber*, and by no means as a distinct species—an opinion which seems to be shared by the greater number of the Italian ichthyologists. The only somewhat constant character is the form and size of certain scutes at the base of the second dorsal. On the other hand, I must maintain that *Z. australis*, Rich. (Australia), is a perfectly different species from *Z. faber*, but perhaps identical with *Z. japonicus*; whether *Z. capensis* is a third species, or to be combined also with *Z. australis*, is a question still to be solved; in any case it will belong to a species distinct from *Z. faber*. It is no doubt with good reason that Mr. Gill has established the genus *Zenopsis* for the species more exclusively inhabiting the deep waters (which can hardly be said of the true species of *Zeus*), such as *Z. conchifer* (Madeira, with *Z. ocellatus* of North America) and *Z. nebulosus* (Japan); but the right of these species to be considered distinct still needs revision, which is the more necessary as the characters indicated are of rather doubtful value, and as we have here to do with species inhabiting the great depths of the oceans, and the geographical distribution is often very extensive in the fish of this category. I shall refer finally to the note by Dr. Günther on a supposed juvenile form of *Mene maculata*, a note which is, so to speak, the harbinger of the interesting particulars which the future will no doubt bring us as to the hitherto unknown metamorphoses of the genera *Zeus* and *Lampris*.

14. PSETTUS; ZANCLUS and GNATHOCENTRUM; PLATAX.

Dr. Günther has already demonstrated that *Gnathocentrum*, Guich. (*Zanclus canescens*, L.), is only a young form of *Zanclus cornutus*; nevertheless the late M. Bleeker, in his 'Atlas Ichthyologique,' still separates them as distinct species. I have therefore thought it right to state that for me also it is an established fact that the genus *Gnathocentrum* and *Z. canescens* are respectively only the young stages of the genus *Zanclus* and of *Z. cornutus*.

Other authors have already pointed out that it is an error to deny palatine teeth to the genus *Psettus*. The four species which constitute it are all armed with five very considerable groups of card-like teeth on the vomer, the palatines, and the pterygoids. These four species are:—the true *P. rhombeus* of Forskål from the Red Sea and the Mauritius (figured in the illustrated edition of Cuvier's 'Règne Animal,' pl. xlii. fig. 2), which authors, except the late Sir John Richardson, have erroneously confounded with *P. argenteus*, Linn., from the East Indies, Australia, and China (see 'Voyage of the Erebus and Terror,' pl. xxxv. fig. 1); *P. falciformis*, Lac., from the East Indies, and *P. sebæ*, C. & V., from the west coast of Africa.

The species of the genus *Platax* are subject during their growth and development to such considerable changes, both in physiognomy and in the form of the body and the coloration, that great confusion and the establishment of a number of nominal species could not but result from them. Nevertheless more light has by degrees been thrown upon this question; and in this respect I may refer especially to M. Bleeker's text and the very instructive plates of his great 'Atlas Ichthyologique.' But (and this is a singular fact) he has neglected a character of which M. Klunzinger first indicated the importance, and without which we shall never arrive at a certain determination of the species. In some species (*P. teira*, Forsk.) the three points of the teeth of the outer row are of the same size; in others (*P. vespertilio*, Bl., =*orbicularis*) the middle point is very distinctly larger; in others, again (*P. batavianus* and *P. pinnatus* (L.), Blk.), it is much larger than the others and completely predominant. It would not appear that we know more than these four species; M. Blecker's fifth species (*P. melanosoma*) is only known from a very young specimen; and the author (whose recent loss is so much deplored) himself regarded it as doubtful.

15. SCOMBERESOX SAURUS.

Dr. Günther having already indicated, although very briefly, the metamorphoses of this fish in their principal features, I may here confine myself to referring to the figures on p. 567 (of the Danish memoir), which represent the different phases of the evolution of the rostrum, as also the physiognomy of the entire fish in one of its youngest stages; and as they are accompanied by a corresponding series of figures representing the very well-known evolution of the same parts in the common Garfish (*Belone vulgaris*), the analogies and differences between the development and transformation of these two nearly allied fishes will strike the eye at once without need of further explanation. I will only add that *Scomberesox saurus* is in the highest degree a pelagic fish, the young of which, easily recognized and impossible to confound with any others, are captured everywhere between the tropics, and even beyond them, especially the youngest forms. It is therefore not difficult to obtain a series of all the successive stages of this genus. Nevertheless, in this great accumulation of more or less juvenile forms derived from very widely separated parts of the great seas of the globe, I have been unable to distinguish more than one species, and have come to the conclusion that, properly speaking, we only know a single species belonging to this genus, namely the pelagic and essentially cosmopolitan species known under the name of *S. saurus* or *S. Camperii*. I must, however, make an exception in favour of *S. brevirostris* of California, a very distinct species described by M. Peters, which is distinguished by an excessive abridgement of the two jaws, a peculiarity to which we find an analogue in the young of *S. saurus* in a certain stage of evolution. A critical examination of the characters indicated for the other species of *Scomberesox* also seems to show that they do not rest upon a very solid basis; but I must leave it to the ichthyologists of the shores of the Mediterranean to elucidate from this point of view the case of *S. Rondeletii* and its relationship to *S. saurus* of the Atlantic. The anatomical character upon which its separation as a distinct species is founded has not, so far as I know, been verified since it was established by M. Valenciennes; hence it does not appear to have any real foundation; and the *Scomberesoces* from the Mediterranean that I have examined possessed a swim-bladder like those of the ocean.

Another eminently pelagic form of this group is *Euleptorhamphus longirostris*. There is therefore a certain probability in favour of the opinion that all the different species which have been established in this genus from individuals fished in the two great oceans at points very distant from one another are only representatives of a single pelagic and cosmopolitan species; but for the more satisfactory verification of this supposition it would be necessary to have at command more considerable materials than any museum at present possesses.

16. POMACANTHUS; HOLACANTHUS; CHÆTODON; THOLICHTHYS; EPHIPPUS.

On the shores of the Antilles there live two species of *Pomacanthus* which are certainly distinguished at all ages by positive and non-equivocal characters, but which in habit, coloration, pattern, squamification, &c. undergo changes so profound and so analogous that we cannot be surprised if ichthyologists on the one hand have created a great number of nominal species, and on the other have not succeeded in separating from each other the very analogous young forms belonging to the two species. The natural consequence of this has been that the connexion between the young and older forms being incapable of being overlooked by those who had sufficient material at their command, authors have fallen into the extreme opposite mistake, and united the two species, including all the phases of their development, under a single species including a whole series of varieties. The considerable materials contained in our two zoological museums now combined (the Royal Museum and that of the University) have enabled me to study the distinctive characters of *P. paru*, Bl., and *P. aureus*, Bl., at all ages, and to confirm, with some modifications, the correctness of the views put forward on this question by MM. Bleeker and Poey.

Holacanthus ciliaris is subject to analogous changes; and *H. formosus* of Castelnau is evidently only a young form of this species. On the contrary, the changes due to age are comparatively insignificant in *H. tricolor*; the young individual represented in pl. v. fig. 6 (of the Danish memoir) has the same large ocellated spot which distinguishes many young Chætodonts. As to the secondary squamification, *Holacanthus ciliaris* stands in the same relation to *H. tricolor* as *Pomacanthus aureus* to *P. paru*. Neither of these genera, so far as we know, passes through the so-called "*Tholichthys*" phase; and it is hardly probable that this case occurs in them.

On the other hand, this phase occurs in so great a number of true Chætodonts, that there can be no doubt it is common to them all. Among the larvæ of Chætodonts or "*Tholichthyes*" that I have had before me I will mention two. One of them (pl. v. fig. 8 of the Danish memoir) represents, in my opinion, one of the stages of *C. sedentarius*, Poey (*gracilis*, Gth.), or of some little-known nearly allied species: the other (fig. 10) I have referred to *Parachætodon ocellatus* (C. & V.); and it would then represent that species in a still younger stage than those at present known, distinguished, among other things, by this peculiarity, that the supraorbital margin terminates in a spine directed obliquely sideways and backwards. Like the Chætodonts, the species of the genera *Ephippus* (*Scatophagus*), *Harpochirus*, and *Chelmo*, after having completely passed through the "*Tholichthys*" phase, so far as such a phase exists, undergo modifications, in the form of the body, the coloration, &c., which merit attention, because they are always sufficiently great to give rise to the establishment of false species when one has not sufficient materials at command. *Ephippus argus* appears to me, however, to include three species:—the Chinese form, with a small number (20–30) of large spots; the East-Indian type species, with many spots of moderate size; and a form from the Sunda Islands with numerous small spots, a pattern which, in young individuals, changes into transverse bands (*E. ornatus*). Strictly speaking we cannot characterize our youngest *Ephippus* as a "*Tholichthys*;" but nevertheless it has so many points in common with this phase of *Chætodon* that we may describe it as being in a "Tholichthyoid" phase. It somewhat resembles a *Chromis* or a *Pomacentrum*: the body is short, squat, and much compressed, the profile of the head nearly vertical, the skin rough and without scales; the fins are naked; the pattern consists of dark transverse bands; the forehead is broad, convex, and protected by two thick, rounded, triangular shields, which meet in the median line, but which, posteriorly, embrace between them the apex of a parietal boss; there is also on each side a temporal boss accompanied by a stout spine, which is the inferior extremity of a triangular suprascapular tubercle; the prolongation of the operculum (*i. e.* of the præoperculum and interoperculum) is divided by a notch into two short rounded parts, of which the superior is directed backwards, and the inferior inwards and downwards.

17. ACANTHURUS, NASEUS; ACRONURUS, KERIS.

We now know that *Keris* and *Acronurus* are respectively only the young forms of *Naseus* and *Acanthurus*. With regard to the development of the *Kerides* and their transformation into *Naseus* I may refer to the illustrations which accompany the magnificent work that Dr. Günther is publishing under the title of 'Fische der Südsee. There are numerous analogies between the young individuals of the two genera—the form of the body, which is short, with strongly arched contours, the streaking and partial metallic lustre of the skin, the greater length of the anterior dorsal and anal spines, the different position of the ventrals relatively to the pectorals, &c. My own contributions to the history of the metamorphoses of the genus *Acanthurus* consist in the indication of the so-called "*Acronurus*" form of the two West-Indian species, *Acanthurus chirurgus* (*phlebotomus*) and *A. cæruleus*, and of the still more curious form under which the so-called "*Acronurus*" shows itself in its first phase. In fact I regard as a young example of *A. cæruleus*, Schn., the very marked form of *Acronurus* represented in pl. v. fig. 4 (of the

Danish memoir), which was captured in the western part of the Atlantic in the neighbourhood of Brazil; it is 34–37 millims. long, discoid, nearly orbicular, colourless, with a silvery band, &c. The most serious objection that could be raised to this interpretation is the presence of a very different young form (pl. v. fig. 3), not larger, and sometimes even smaller, which, however, notwithstanding its small size, is already in a comparatively more advanced stage, transitional between *Acronurus* and *Acanthurus*, and which must with absolute certainty be referred to *A. cæruleus*. Whether this apparent contradiction arises from the circumstance that we have to do here with different though nearly allied species, or is due to the fact that the metamorphosis may take place a little earlier or a little later, is a question which I shall leave undecided for the present. Another, younger specimen of the same form, perhaps of the same species, but captured N.N.E. of the Bermudas, and characterized especially by the comparatively enormous development of the anterior (strictly the second) spine of the dorsal and anal, which gives these little nearly rhomboidal fishes a very peculiar aspect, makes known to us the "*Acronurus*" phase at a period still less advanced, and which cannot be very far distant from the time of exclusion from the egg.

As a contribution to the evolution of the *Acanthuri* I must also cite the change which the dental apparatus undergoes in *A. strigosus* (*ctenodon*). The adult fish presents this peculiarity—the teeth are pectinated only on one side; the young individuals still in the "*Acronurus*" phase have them pectinated on both sides. As these little fishes pass from the stage of *Acronurus* to that of *Acanthurus* the teeth with unilateral pectination make their appearance and predominate over those with double pectination.

18. FISTULARIA VILLOSA; CENTRISCUS VELITARIS and BREVISPINIS; CENTRISCOPS and ORTHICHTHYS.

Fistularia villosa of Klunzinger is only a young form of *F. serrata*, Cuvier. The small close-set spines which clothe its skin occur also in young examples of *F. tabacaria*. It is not easy to differentiate these two species (of the east and west) in consequence of the modifications which their proportions undergo during growth &c.; but it is still more difficult to distinguish the two forms of *Aulostomus*, the specific value of which seems to me very doubtful.

Centriscus gracilis, Lowe, of which our Museum possesses several young examples from the Atlantic, south and north of the equator, must almost be regarded as a pelagic species.

The young individuals differ considerably from the adults by the shorter form of the body, their shorter tubiform muzzle, and by the well-marked development of the teeth, of the scutes of the skin, and of the hooked spines of the scales. There is no doubt that "*C. velitaris*," Pallas, is a nearly adult form, and *C. brevispinis*, Kn., Steind., a very young form of *C. gracilis*, and that these two specific names must disappear, as well as the genus *Orthichthys* of Mr. Gill. His genus *Centriscops* (type *C. humerosus*, Rich.) is better founded as regards the physiognomy, but is not based upon any important character or any special peculiarity of organization.

* * *

Finally, in a postscript, I refer to the considerable changes which occur in some groups of marine fishes which I have not had the opportunity of examining in this memoir, but which have been elucidated by other authors, or will be so, I hope, hereafter by myself. I may cite, for example, the metamorphoses (1) of the Pleuronectidæ, which have especially been elucidated by MM. Jap. Steenstrup and Alex. Agassiz; (2) of certain Gadoids; the *Couchiæ*, notwithstanding what may have been said, are the young of various species of *Motella*, and *Hypsiptera argentea* the young form of a Phycid; (3) of the *Macruri*, *Ophidia*, and *Trachypteri*, which have been elucidated by Mr. Emery; (4) of the Sunfish (*Mola rotunda* and *Ranzania truncata*), of which I hope soon to be able to give an explanation conjointly with M. Steenstrup; and, lastly, (5) of *Ansonia Cuvieri*, Risso (*Luvarus imperialis*), of which M. Giglioli has demonstrated that *Diana semilunata*, Risso (*Astrodermus coryphænoides*), is the young form. This last is certainly one of the most remarkable of the transformations presented by the family of the Scomberoids, otherwise so rich in examples of this kind, to the knowledge of which I have also made some contributions in this memoir.

XI.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, F.R.S., and C. E. Broome, Esq., F.L.S.

[Continued from ser. 5, vol. iii. p. 212.]

[Plate III.]

1838. *Agaricus* (Amanita) *nitidus*, Fr.
Mattishall, Rev. J. M. Duport.
Several specimens have been forwarded, some exactly agree-

ing with the definition of Fries in the thick indurated angular warts, while others approach so near to *A. mappa* that it is difficult to distinguish them.

1834. *A.* (Lepiota) *granulosus*, Batsch, var. *rufescens.*

A curious form was found near Bristol by Mr. Bucknall, quite pure white at first, then partially turning red, and in drying acquiring everywhere a rufous tint.

1835. *A.* (Lepiota) *seminudus*, Lasch.

Clifton, Mr. Bucknall. Coed Coch, 1880.

1836. *A.* (Lepiota) *Bucknalli*, B. & Br. Olidus, pileo e campanulato convexo, albo, stipiteque deorsum pulvere lilacino conspersis, lamellis albis marginem vix attingentibus.

Pileus nearly 1 inch across; stem 3 inches high, dilated at the base. A doubt has been suggested whether this may not be Quélet's var. *lilacinus* of *A. seminudus*; but as he does not mention the strong gas-tar smell, they cannot be the same. The spores in this species are much longer, ·00027 by ·0001, in *A. seminudus* ·00015 by ·00007 inch.

1837. *A.* (Armillaria) *focalis*, Fr.

On bare ground under old laurel trees. Coed Coch.

Pileus 4 inches across, pale fawn-coloured, darker above, slightly virgate, *extreme* margin involute; stem 5 inches high, 1½ inch thick at base, variously lacerated; mycelium white, fibrillose, ring very broad (to which the specific name alludes), superior; odour farinaceous; substance tender. Almost agreeing in dimension with the var. "*Goliath*," and certainly one of the finest British species.

1838. *A.* (Tricholoma) *stans*, Fr.

This species was formerly called by Fries *A. pessundatus*, and was found of large size at Coed Coch. The figure in the 'Icones' marked "*pessundatus*" is now referred to *A. stans*. The true *A. pessundatus* was sent by Mr. Renny from Lucerne.

1839. *A.* (Tricholoma) *guttatus*, Schæff.

This curious species was found at Downton by Mr. Howse, who brought an excellent drawing to the meeting at Coed Coch.

1840. *A.* (Tricholoma) *tumidus*, P.

Coed Coch. Exactly according with Krombholz's figure.

**A.* (Tricholoma) *lixivius*, Fr.

There is no doubt that Sowerby's *A. compressus* is this species.

1841. *A.* (Clitocybe) *hirneolus*, Fr.

Coed Coch, Oct. 1877.

1842. *A.* (Clitocybe) *amarus*, Fr.

Holm Lacy, Mr. Perceval, 1878.

1843. *A.* (Clitocybe) *pithyophilus*, Fr.

Coed Coch, 1880.

1844. *A.* (Clitocybe) *cryptarum*, Letellier. Dense cæspitosus, pileis subconicis depresso-flocculentis brunneis maculatis; stipitibus albis substriatis virgatis sursum attenuatis plus minus compressis anguste fistulosis; lamellis angustis arcuatis subdecurrentibus albis.

Coed Coch. On sawdust. Habit that of *A. tumulosus*. Pilei varying much in size, according to the denseness of the clusters. Inodorous, insipid; stem mottled within.

1845. *A.* (Clitocybe) *decastes*, Fr.

Coed Coch. On sawdust. Agreeing closely with the figure of Fries in the 'Icones;' but we are doubtful whether what we find is not an advanced stage of *A. cryptarum*—a matter which requires future observation.

1846. *A.* (Clitocybe) *Trogii*, Fr. (*A. suaveolens*, Trog).

Coed Coch. The colour approaching that of *A. metachrous*.

1847. *A.* (Clitocybe) *senilis*, Fr.

Coed Coch, 1880.

1848. *A.* (Collybia) *macilentus*, Fr.

Coed Coch, 1880.

1848 *bis*. *A.* (Collybia) *stolonifer*, Jungh.

Perth, Dr. Buchanan White.

1849. *A.* (Mycena) *adonis*, Bull.

Garthewin, Mr. Brownlow Wynne. The scarlet form.

1850. *A.* (Omphalia) *hydrogrammus*, Fr.

Coed Coch, 1880.

1851. *A.* (Omphalia) *infumatus*, B. & Br. Pileo obtuso nec membranaceo e viridi infumato; stipite tenui, luteo; lamellis paucis latis decurrentibus distantibus luteis.

On bark. Amongst moss. Garthewin, Mr. Brownlow Wynne. Pileus 2 lines across; stem 1 inch high, not a line thick, dilated at the base, tomentose, especially below; gills about twelve, with smaller intermediate. Allied to *A. umbelliferus*, but quite distinct from all its varieties.

1852. *A.* (Omphalia) *offuciatus*, Fr.

Coed Coch, 1880.

1853. *A.* (Omphalia) *abhorrens*, B. & Br. Odor stercorarius; pileo umbilicato brunneo; stipite gracili concolori; lamellis decurrentibus.

Coed Coch. On lawn with *A. retostus*.

**A.* (Pleurotus) *ulmarius*, Bull.

A specimen was found in the Coed-Coch forage, agreeing with *A. tessulatus*, Bull. The spots arising from the presence of a species of *Fusisporium*; the same appearance, arising from the same cause, occurred in *Agaricus orcella*.

1854. *A.* (Pleurotus) *laurocerasi*, B. & Br. Ostreæformis, pileo sulcato brunneo, cute tenuissima; stipite obsoleto, lamellis venoso-connexis; sporis ovatis.

On the naked trunk of a laurel. Coed Coch, Oct. 14, 1879.

Pileus rather more than an inch across; the cuticle is extremely thin, and gives way at the furrows so as to expose the substance of the pileus. Spores ·0008 millim. long.

1855. *A.* (Pleurotus) *palmatus*, Bull.

The spores of this species are pale ochre-coloured, ·0004 inch in diameter; it has the same right to be placed in *Pleurotus* as the rosy-spored *A. euosmus.*

1856. *A.* (Pluteus) *spilopus*, B. & Br. Nanus, pileo brunneo ruguloso; stipite flexuoso atro-punctato; sporis globosis lævibus.

C. E. Broome. Allied to *A. nanus.*

1857. *A.* (Leptonia) *æthiops*, Fr.

Coed Coch, 1880.

1858. *A.* (Eccilia) *atrides*, Fr.

Hereford. This is not the plant figured by Quélet.

1859. *A. acetabulosus*, Sow.

This curious species has never been satisfactorily elucidated. The occurrence of an allied form from Swan River necessitates the proposition of a new section (*Acetabularia*) analogous to *Volvaria* and *Chitonia.* The spores in the original specimen of Sowerby, now (with the drawing) in the British Museum, are clay-coloured.

1860. *A.* (Pholiota) *erebius*, Fr.

This is clearly the same species with *A. denigritus*, the spores of which are brown.

1861. *A.* (Pholiota) *ombrophilus*, Fr.

Coed Coch, in great abundance. It has also been sent to Mr. Phillips.

1862. *A.* (Pholiota) *subsquarrosus*, Fr.

Found in Herefordshire by Mr. Howse, who brought specimens and a drawing to Coed Coch.

1863. *A.* (Pholiota) *tuberculosus*, Fr.

On Sawdust, Coed Coch (and therefore not rooting into wood as in the typical form), together with the ringless form figured by Schæffer.

1864. *A.* (Pholiota) *curvipes*, Fr.

On sawdust. Coed Coch, 1879–1880.

1865. *A.* (Inocybe) *muticus*, Fr.

Coed Coch. In great abundance, 1880.

1866. *A.* (Inocybe) *destrictus*, Fr.

Coed Coch, 1880.

1867. *A.* (Hebeloma) *mesophæus*, Fr.

Coed Coch, 1880.

1868. *A.* (Hebeloma) *nudipes*, Fr.

Coed Coch, 1880. M. Cornu also found specimens exactly agreeing with Kalchbrenner's figure.

1869. *A.* (Hebeloma) *firmus*, P.

Coed Coch, 1880.

1870. *A.* (Naucoria) *hamadryas*, Fr.

Specimens gathered by Mr. Plowright at Brandon appear to belong to this species, but have the fishy odour of one or two *Nolaneas*.

1871. *A.* (Naucoria) *abstrusus*, Fr.

On sawdust. Coed Coch, 1880.

1872. *A.* (Naucoria) *tenax*, Fr.

On a grassy walk. Coed Coch, 1879. Spores ovate, even.

1873. *A.* (Naucoria) *rubricatus*, B. & Br. Cæspitosus; ex albo rubricatus; pileis pusillis demum planiusculis, stipitibus gracilibus.

On decayed twigs or petioles. Hereford, Miss Ruth Berkeley, 1878.

1874. *A.* (Psalliota) *comptulus*, Fr.

Coed Coch, 1880. In several places.

1875. *A.* (Stropharia) *inunctus*, Fr.

A pale form occurred at Sibbertoft, which we should have been inclined to refer rather to *A. albocyaneus*; but the cuticle peeled off with the greatest ease, and after a heavy rain it dripped with gelatinous matter. It resembled greatly Fries's figure of *A. torpens*, var.

1876. *A.* (Hypholoma) *appendiculatus*, Bull., var. *lanatus*.

A curious form occurred in a hollow apple-tree at Sibbertoft, densely woolly when young, traces of the woolly coat remaining at the apex when the pileus is fully expanded.

1877. *Coprinus narcoticus*, Batsch.

Shewsbury, W. Phillips. •Smell hig

1878. *Cortinarius* (Myxacium) *salor*,

Coed Coch. In considerable abundance, but rather decayed. The base of the stem was strangely swollen, showing the original universal veil halfway up the swelling, which ends abruptly. The head still covered with the bluish slime.

1879. *C.* (Myxacium) *illibatus*, Fr.

Coed Coch. A single specimen only.

**C.* (Dermocybe) *myrtillinus*, Fr.

Coed Coch. At first sight resembling *A. nudus*, but known by the colour of the spores and the veil.

1880. *C.* (Telamonia) *impennis*, Fr.

Amongst dead leaves. Bomere, W. Phillips. Mr. Houghton sent from Tibberton Firs a species exactly intermediate between this and the common *C. torvus.*

1881. *C.* (Telamonia) *flabellum*, Fr.

Coed Coch, 1880. A single specimen.

1882. *C.* (Telamonia) *paleaceus*, Fr.

Coed Coch, Hereford, &c. Apparently a very variable species.

1883. *C.* (Hydrocybe) *jubarinus*, Fr.

Coed Coch. Abundant early in 1879.

1884. *C.* (Hydrocybe) *fasciatus*, Fr.

Coed Coch. Umbo very acute.

1885. *Hygrophorus sciophanus*, Fr.

Coed Coch. Small specimens. Gigantic specimens of this occur near Geneva, as found by Mr. Renny, with a darker form, of both of which we have excellent drawings.

1886. *H. subradiatus*, Schum.

Salop, W. Phillips, Esq.

1887. *Lactarius intermedius*, Krombh.

Norfolk, the Rev. J. M. Du Port and Mr. Plowright.

The specimens agree with Krombholz's plant, except that when fresh and dried they are more or less zoned as in *L. insulsus.*

1888. *Russula Queletii*, Fr.

Very common, confounded probably with *R. rubra.*

1889. *Marasmius urens*, Fr.

A curious form with the pileus becoming very dark when fully grown, and exceedingly acrid, occurred in a hothouse at Coed Coch in profusion for many weeks in September and October, with the white form of *A. cepæstipes* and *A. meleagris.*

**Lentinus fimbriatus*, Curr.

On a stump. Edenbridge, J. Renny, Aug. 1879.

1890. *Polyporus* (Resupinati) *umbrinus*, Fr.

Knowle Park, Burchell.

1891. *P.* (Resupinati) *reticulatus*, P.

Hereford, 1878.

1892. *Dædalea aurea*, Fr.

Hereford. Imbricated, the veins for the most part straight and radiating.

**Hydnum rufescens*, Fr.

Dolgelley, Miss Ruth Berkeley. Differing from *H. repandum* in having the pileus distinctly tomentose, in this case studded with little villous warts.

1893. *H. acre*, Quélet.

Forres, Rev. J. Keith, 1878.

* *Thelephora intybacea*, P.

Glamis, Rev. J. Stevenson.

1894. *Cyphella Bloxami*, B. & Phill. Alba floccoso-membranacea, disco flavescente crenato-lobato; floccis lævibus; sporophoris turbinatis.

On *Ulex*, Twycross, Rev. A. Bloxam.

Spores ·0003–·0004 inch. Spores terminating slightly branched threads.

1895. *Clavaria canaliculata*, Quélet.

Coed Coch. In several places; the same species was sent by Mr. Renny from Lucerne.

* *Geaster limbatus*, Fr.

Garthewin, Denbighshire, Mr. Brownlow Wynne.

1896. *Myxosporium dracænicola*, B. & Br. Aurantium, sporis ovatis.

On leaves of *Dracænæ*, spores ·00035 inch long, ·0002 wide. On the same leaves, scattered in the form of minute black specks, was a *Diplodia* with oblong uniseptate spores, slightly constricted in the middle, colourless, and probably immature, ·0006–·0007 long. These are doubtless states of more perfect fungi, but are mentioned here because they are connected with a disease which seems fatal to *Dracænæ*.

1897. *Glæosporium cytisi*, B. & Br. Maculis albis quandoque rubro-cinctis, peritheciis minutis, sporis minutis ellipticis.

On *Cytisus laburnum*. Glamis, Rev. J. Stevenson.

1898. *Protomyces melanodes*, B. & Br.

On leaves and inflorescence of *Phlox* (Gard. Chron. Sept. 1879).

1899. *Cryptosporium turgidum*, B. & Br. Peritheciis globosis prominulis obtusis; sporis curvis utrinque acutis, obscure triseptatis.

On ash, Rev. A. Bloxam. Spores ·0008 long.

1900. *Sporonema phacidioides*, Desm.

On leaves of *Medicago maculata*, Wimbledon.

1901. *Leptothyrium asterinum*, B. & Br. Maculæforme incrassatum margine rubro, sporis oblongis curvatis binucleatis, ·001–·0015 long.

Plate III. fig. 1. Spores and flocci, highly magnified.

On *Aster tripolium*. Fleetwood, Rev. A. Bloxam.

1902. *Septoria violæ*, Rab.

On leaves of *Viola canina*, Fergusson.

1903. *Gymnosporium lateritium*, B. & Br. Effusum, lateritium, sporis obovatis breviter pedicellatis.

On wych elm. St. Catherines, C. E. Broome. Looks like a stratum of finely powdered brickdust. Spores ·0003

1904. *Selenosporium tubercularioides*, Cd.

On raspberry. Orton Wood, Rev. A. Bloxam.

1905. *Uredo plantaginis*, B. & Br. Maculis pallidis, pustulis minutis apice tantum ruptis; sporis ellipticis luteis.

On *Plantago*, Woodnewton. On *P. lanceolata*, Dolgelley, Ralfs.

1906. *Isaria floccosa*, Fr.

On a caterpillar. Milton, Norths., Mr. J. Henderson.

1907. *Fusarium equiseti*, Desm.

Oswestry. Spores at first ·0002 long, at length ·0015.

PLATE III. fig. 2. *a*, flocci with young spores; *b*, spores, young and old.

1908. *T. salicinum*, Cd.

On willow. Twycross, Rev. A. Bloxam.

1909. *Monotospora elliptica*, B. & Br. Punctiformis, sporis ellipticis binucleatis quandoque uniseptatis.

On herbaceous stems.

PLATE III. fig. 5. Flocci with spores, highly magnified.

1910. *Helminthosporium molle*, B. & C., Notices of new Am. Fungi, p. 113.

On *Ilex*. Powerscourt.

1911. *Chalara longipes*, Strauss.

On old walnuts &c., Dr. Buchanan White. We cannot identify this with any of the species figured by Saccardo.

1912. *Aspergillus griseus*, Lk.

Kings Cliff. On various decaying substances.

1913. *Penicillium saponis*, B. & Br. Nigrum, monilibus e cellulis 2–3 oriundis; sporis globosis.

On soap, Rev. J. Hort.

PLATE III. fig. 3. Plant, highly magnified.

1914. *P. abnorme*, B. & Br. Candidum, floccis tenuibus in corpus turbiniforme desinentibus, sporis minutissimis.

On leaves of *Trientalis europœa.*

PLATE III. fig. 4. Flocci with their receptacles and spores, highly magnified.

1915. *Zygodesmus terrestris*, B. & Br. Fuscus, sporis subellipticis vel citriformibus, primum lævibus, demum asperulis.

On bare chalk. Crundall, Kent. We have also had the same from Dr. Montagne, marked Haddous. Forming a thin brown stratum.

1916. *Peronospora dipsaci*, Tul.

On *Dipsacus sylvestris.*

1917. *Ramularia veronicæ*, B. & Br. Tota alba, floccis brevibus, sporis oblongis angustis deorsum leviter attenuatis.

On *Veronica agrestis*, Sibbertoft. This and *Peronospora* *obliqua*, Cooke, clearly belong to the genus *Ramularia* as revived by Saccardo.

PLATE III. fig. 7. Flocci and spores, highly magnified.

1918. *Coccotrichum brevius*, B. & Br. Cæspitulis subglobosis rufis, floccis parce ramosis articulatis, articulis brevibus, sporis ellipticis granulatis.

Leigh Wood, on bark, C. E. Broome.

Of a rich red-brown; when placed in water it tinges it with the same colour. When young the tufts are distinct; they afterwards become confluent. When dry they assume a buff or ferruginous tint.

PLATE III. fig. 8. *a*, plant, natural size; *b b*, flocci with heads of spores, magnified; *c*, spores, highly magnified.

1919. *Polyactis capitata*, B. & Br. Tota alba, floccis ex articulis tumidis basi sitis oriundis trifidis bifidisque, sporis obovatis.

On *Cheiranthus*, Sibbertoft. Spores ·001 long.

1920. *Stachylidium trabeum*, B. & Br. Pallidum, floccis parce ramosis, apicibus 3–4fidis, sporis globosis.

On an old beam. Kings Cliff, Nov. 15, 1864.

PLATE III. fig. 6. Flocci with spores, highly magnified.

1921. *Helvella Klotschei*, Cooke.

A single specimen in the Fernery, Coed Coch, Mrs. Lloyd Wynne, which was submitted to Dr. Cooke for identification.

* *Verpa digitatiformis*, P.

With *Morchella gigas*, M., and the following. In some of the specimens the head is minutely reticulated, as it has also occurred to Mr. Broome.

1922. *V. speciosa*, Vittadini.

Coed Coch. Agreeing in size and colour with Vittadini's figure; but the sporidia are not oblong, so that there is some doubt about the species.

1923. *Dermatea cinnamomea*, DC.

On maple. Leigh Wood, Dec. 1878.

Sporidia ·0015–·00045 long, finely granulated.

1924. *Cenangium Rubi*, Dub.

Glamis, Rev. J. Stevenson.

1925. *Eurotium lateritium*, Lk.

Dolgelley, J. Ralfs.

1926. *Sphæria Stevensoni*, B. & Br. Nigra, fragilis, sparsa, subglobosa, glabra; sporidiis oblongis, 2–3-septatis.

On dead wood. Glamis, Rev. J. Stevenson. Sporidia ·0002 long. Under the lens it splits with pressure into several fragments.

XII.—*On a Collection of Butterflies from Nikko, Central Japan.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE following is an account of a large series of Butterflies collected by Mr. Charles Maries in Nippon (or Niphon) Island, and certainly one of the richest of any collection which has hitherto come to England, since it contains no less than 118 species.

Mr. Maries also collected in the island of Yesso, where he obtained the *Satyrus Schrenckii* of Ménétriés and other rare species, and again in the province of Kiukiang, China, where he captured a good series of *Papilio alebion*, a new species allied to the latter, a pair of *Luchdorfia puziloi*, and other rarities, all of which are now in the collection of the British Museum.

List of Species obtained in Nikko.

1. Danais tytia, *Gray*.
2. Melanitis ismene, *Cram.*
3. Satyrus bipunctatus, *Motsch.*
4. Neope Gaschkevitchii, *Mén*
5. —— niphonica, sp. n.
6. —— callipteris, *Butl.*
7. Pararge deidamia, *Eversm.*
8. —— achinoides, *Butl.*
9. Lethe diana, *Butl.*
10. —— Whitelyi, *Butl.*
11. —— consanguis, sp. n.
12. —— sicelis, *Hew.*
13. —— Maackii, *Brem.*
14. Erebia niphonica, *Jans.*
15. Mycalesis perdiccas, *Hew.*
16. —— gotama, *Moore.*
17. Ypthima evanescens, sp. n.
18. —— argus, *Butl.*
19. Apatura substituta, *Butl.*
20. Dichorragia nesimachus, *Fabr.*
21. Hestina japonica, *Feld.*
22. —— charonda, *Hew.*
23. Limenitis sibilla, *Ochs.*
24. Neptis ludmilla, *H.-Sch.*
25. —— Pryeri, *Butl.* (arboretorum, *Oberth.*).
26. —— alwina, *Brem.*
27. —— intermedia, *Pryer.*
28. Araschnia fallax, *Jans.*
29. —— burejana, *Brem.*
30. Pyrameis cardui, *Linn.*
31. —— indica, *Herbst.*
32. Vanessa angelica, *Cram.*
33. —— Pryeri, *Jans.*
34. —— hamigera, *Butl.*
35. Vanessa xanthomelas, *Denis.*
36. —— io, *Linn.*
37. —— antiopa, *Linn.*
38. —— glauconia, *Motsch.*
39. Argynnis sagana, *Dbl.*
40. —— paphioides, sp. n.
41. anadyomene, *Feld.*
42. lysippe, *Jans.*
43. - japonica, *Mén.*
44. - pallescens, *Butl.*
45. locuples, sp. n.
46. nerippe, *Feld.*
47. fortuna, *Jans.*
48. niphe, *Linn.*
49. Libythea lepita, *Moore.*
50. Curetis acuta, *Moore.*
51. Lampides bellotia, *Mén.*
52. Lycæna Pryeri, *Murr.*
53. —— ladonides, *De l'Orza*, (kasmira ?, *Moore*).
54. —— argia, *Mén.*
55. —— argus, *Denis.*
56. —— euphemus, *Herbst.*
57. Scolitantides hamada, *Druce.*
58. Niphanda fusca, *Brem.*
59. Chrysophanus timæus, *Cram.*
60. Thecla sæpestriata, *Hew.*
61. —— lutea, *Hew.*
62. —— japonica, *Murr.*
63. —— fasciata, *Jans.*
64. —— taxila, *Brem.*
65. —— stygiana, *Butl.*
66. —— mera, *Jans.*
67. —— attilia, *Brem.*
68. —— enthea, *Jans.*

69. Thecla arata, *Brem.*
70. Amblypodia asinarus, *Feld.* (japonica, *Murr.*).
71. —— turbata, sp. n.
72. Colias palæno, *Linn.*
73. —— poliographus, *Motsch.*
74. —— Elwesii, sp. n.
75. —— simoda, *De l'Orza.*
76. —— pallens, *Butl.*
77. —— subaurata, sp. n.
78. Terias Jægeri, *Mén.*
79. —— betheseba, *Jans.*
80. —— Mariesii, *Butl.*
81. —— anemone, *Feld.*
82. —— mandarina, *De l'Orza.*
83. Gonepteryx aspasia, *Mén.*
84. —— nipalensis, *Gray.*
85. Synchloe melete, *Mén.*
86. —— megamera, *Butl.*
87. —— crucivora, *Boisd.*
88. Euchloe scolymus, *Butl.*
89. Parnassius glacialis, *Butl.*
90. Papilio teredon, *Feld.*
91. —— asiaticus, *Mén.*
92. —— hippocrates, *Feld.*
93. —— xuthus, *Linn.*
94. Papilio nicconicolens, sp. n.
95. —— Maackii, *Brem.*
96. —— Dehaanii, *Feld.*
97. —— japonica, *Butl.*
98. —— macilentus, *Jans.* (scævola, *Oberth.*).
99. —— tractipennis, sp. n.
100. —— demetrius, *Cram.*
101. —— spathatus, sp. n.
102. —— Thunbergii, *Sieb.*
103. Hesperia japonica, *Murr.*
104. Pamphila pellucida, *Murr.*
105. —— guttata, *Brem.*
106. —— rikuchina, *Butl.*
107. —— ochracea, *Brem.*
108. —— sylvatica, *Brem.*
109. —— herculea, sp. n.
110. —— flava, *Murr.*
111. Pyrgus sinicus, *Butl.*
112. —— maculatus, *Brem.*
113. Daimio tethys, *Murr.*
114. —— Felderi, sp. n.
115. Astictopterus ornatus, *Brem.*
116. Thanaos montana, *Brem.*
117. —— rusticanus, *Butl.*
118. Antigonus vasava, *Moore.*

Descriptions of the new Species.

Neope niphonica, sp. n.

Allied to *N. Gaschkevitchii*, rather smaller and shorter in wing; above considerably darker, with orange, instead of white fringe. Primaries below yellower, all the markings thicker and darker, the discoidal markings more uniform, the third being less zigzag or 3-shaped: secondaries with the discal ocelli smaller and far more uniform in size; the base, abdominal area, subbasal spots, central belt, and external area filled in with blackish olivaceous; the external area washed with lilac; the pale band just in front of the ocelli spotted with brown and tinted with lilacine below the angle. Expanse of wings 2 inches 7–8 lines.

The natural position for this species is between *N. Gaschkevitchii* and *N. agrestis*. We have eight males and one female, which I have compared with twelve *N. Gaschkevitchii*, and find the differences constant.

Lethe consanguis, sp. n.

Allied to *L. Whitelyi*, similar on the upper surface, but differing below in the outer edge of the broad central belt of primaries being more transverse, obliquely excised on the costa, very slightly zigzag on the second median interspace, bordered externally with white as usual; three decreasing ocelli in a lilac nebula towards apex, as in typical *L. diana*: secondaries with the zones of the ocelli and the submarginal band silvery (or steel) blue instead of lilac, the third ocellus reduced to a mere point. Expanse of wings 2 inches 4 lines.

It is possible that this may prove to be a beautiful variety of *L. Whitelyi*; but it differs conspicuously from our examples of that species, particularly in the vivid coloration of the ocellus-zones and submarginal band below.

Ypthima evanescens, sp. n.

Above like *Y. lisandra*, below more like *Y. zodia*: wings below white, densely striated with short brown lines and crossed before the middle by two subparallel yellowish stripes, the outer one angulated on the secondaries; external border also regularly yellowish, but paler than the stripes: primaries with a large subapical yellow-zoned black ocellus with two silver pupils; secondaries with six very minute yellow-zoned black ocelli with single silver pupils; these ocelli are arranged as in *Y. stellera*. Expanse of wings 1 inch 5 lines.

One example.

Argynnis paphioides, sp. n.

Near to *A. paphia* of Europe, but considerably larger, the primaries more produced, the female always greenish above (but not so dark as the variety *A. valezina*), under surface with the silver bands and border of secondaries much more metallic. Expanse of wings, ♂ 3 inches, ♀ 3 inches 4 lines.

A long series of specimens.

Argynnis locuples, sp. n.

♂. Size of *A. vorax*, pattern and coloration of the upper surface similar, excepting that the spots of the discal series are more elongated, and the submarginal connected lunate spots of the secondaries are rather broader. Primaries below with silvery apical submarginal spots, as in *A. jainadeva*, the darker markings on the apical area cupreous brown with olivaceous margins, the discoidal markings smaller, otherwise as in *A. vorax*: secondaries below similar in pattern to *A. pallescens*, but the ground-colour more golden in tint, and the submarginal silver spots less sharply defined; the disk, between the series of ferruginous ocelloid spots and the green-bordered silver submarginal series, is clear buff-colour. Expanse of wings 2 inches 10 lines.

♀. Larger than the male, duller and greener above, with all the black spots larger. Below with eight additional subapical silver spots on the primaries, five of them forming a decreasing submarginal series, the ground-colour duller and more uniform in tint: secondaries with all the silver spots considerably larger, the third series well defined and continued to the submedian vein, so that there are five complete series; the submarginal series formed of broad black-bordered arched spots; the ground-colour rather deeper, the ocelloid ferruginous spots frequently larger than in the male, but always darker. Expanse of wings 2 inches 10 lines to 3 inches 3 lines.

A long series of specimens.

The natural position of this species will be between *A. vorax* and *A. pallescens*; it appears to represent *A. chloradippe* in Japan.

Colias Elwesii, sp. n.

♂. Above lemon-yellow, the basal three sevenths and costal border of primaries densely irrorated with greenish grey; basal fourth of costal margin ferruginous; apical area (from apical two fifths of costa to external third of third median branch) and a broad external border, sinuated in second median interspace and at external angle, black; a subapical series of irregular yellow spots, a large broad lunate spot on the border in the first median interspace and a small spot below it yellow; a large black discocellular spot: secondaries irrorated with grey; a submarginal series of large subconfluent sulphur-yellow spots, bounded internally towards the costa by a few blackish scales; apical border and three large spots at the extremities of the radial and second and third median branches black; fringe varied with rose-colour; a large bright orange spot at the end of the cell: body normal. Under surface lemon-yellow, the characters of the upper surface indistinctly traceable through the texture of the wing, costal margins and fringes rose-coloured: primaries with a diamond-shaped silver-centred black discocellular spot; three squamose blackish spots parallel to the outer margin on the median and internomedian interspaces: secondaries with an ochreous-bordered purple-edged silver spot at the end of the cell; a discal arched series of purplish-red dots commencing with an angular spot of the same colour upon the costa: body whitish, legs rosy. Expanse of wings 2 inches 8 lines.

♀. Above like the male, excepting that all the submarginal lemon-yellow spots of the secondaries are bounded internally by blackish scales, which, however, get less distinct towards the abdominal area; below with rather brighter primaries, the three discal spots larger, brown, and the series continued by two smaller brown spots or dots on the radial interspaces and two costal spots, the secondaries with a small additional silver-centred spot above the one at the end of the cell; otherwise exactly like the male. Expanse of wings 2 inches 5½ lines.

Albino ♀. Above creamy white, the basal area and costal border of primaries and the secondaries bluish grey; the spots on the border smaller than in the male, the discocellular spot larger; the marginal spots of secondaries diffused and subconfluent, the first being confluent with the apical border; the submarginal spots only slightly paler than the ground-colour, smaller than in the ordinary form, the first two bounded internally by large black lunate spots, the others by a few blackish scales; orange spot very pale. Primaries below white, with greyish basal area, the discal series of spots completed, beginning in the interno-median and median interspaces with three decreasing triangular black spots, after which they are small and red-brown; apical area greenish sulphur-yellow, brighter at outer margin; costal margin and fringe rose-red: secondaries green, washed with yellow towards the base, fringe rose-red; markings as in the ordinary female. Expanse of wings 2 inches 8 lines.

This is a tolerably common species, allied to *C. simoda*, but differing constantly from that form in the greater length of the costal margin of the primaries, the larger pale submarginal spots, with less-defined internal limiting spots on the secondaries, the maculated character of the border on these wings, the noticeably paler colour of the under surface, the increased number of the discal spots on the under surface of the females, and the greater size of the albino females.

I have come to the conclusion that this species is constant (so far as *Colias* ever is so) to the characters above laid down, after examining nearly 200 specimens of the *Hyale* group from various parts of Japan. Mr. Elwes says (Trans. Ent. Soc. 1880, p. 144) "it would be most unlikely that *in such a genus** four species of one group should exist in Japan alone, or, rather, in *that very small part of Japan* from which collections have come." Can Mr. Elwes be speaking seriously when he makes this statement? Is it a fact that the collections received were obtained from so limited an area that it is "unlikely" that distinct allied species should come to hand? Are Hakodaté, Yokohama, Nikko, and Nagasaki localities so close together and so identical in their conditions of life that it is absurd to look for allied but distinct species in collections from these localities?

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* Mr. Elwes does not explain this expression; and I fail to comprehend its meaning.

It appears to me that there must be sufficient variation of conditions in 260,000 square miles of insulated land, divided into three larger islands by intervening straits, and exhibiting considerable degrees of elevation, to render the existence of different species in the same group less a probability than a certainty.

That it does "require special training to appreciate" specific differences is a truism which no entomologist who has specially studied any branch of his science will be inclined to dispute; for that very reason it is unwise for any naturalist, when taking up the study of a branch of science comparatively new to him, to plunge at once into the most difficult genus in that branch, and criticise the work of all previous labourers in the same field.

Whilst referring to the paper by Mr. Elwes, it will save further trouble to call attention now to some observations of his on p. 141. Mr. Elwes says that I have "*described* no less than four supposed species and varieties nearly allied to this," meaning *C. erate*; and, as though to confirm this surprising statement, he inserts in brackets "see P. Z. S. 1880." Although not aware that I had described any species allied to *C. erate* from Candahar, either supposed species or variety, I took the trouble to look through the 'Proceedings of the Zoological Society of London' for 1880; but I could not find any descriptions of *Colias* by myself. It is a pity that Mr. Elwes did not give a reference to the page, as it might have tended to explain his meaning. Mr. Elwes then proceeds to say that he *entirely* fails to follow my distinctions, and goes on to prove it by declaring that what I call *C. erate* is like the specimens of that species from South Russia and the Punjaub, that what I call *C. helictha* differs from *C. hyale* just as Lederer says it does *, that what I call *C. sareptensis* is identical with *the form* of *Hyale* found all over Asia, from the Himalayas to Japan (specifying, however, *three forms* which have hitherto come only from Japan), and, lastly, that what I call *C. pallida* is just what Staudinger says it is, a white variety of *C. erate* ♀.

I need say no more respecting this paper on *Colias*; it possibly may not seriously affect the study of the genus, since most Lepidopterists will probably hold the same opinions now as before its publication; the only cause for regret is that Mr. Elwes did not pause before publishing that in haste of which it is possible he may, after more profound study, repent at leisure.

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* Mr. Elwes repeats the obviously erroneous suggestion that *C. helictha* is a hybrid between two species not occurring in the same country.

Colias subaurata, sp. n.

♂. Above very similar in coloration and pattern to the preceding species, but with distinct depressed marginal triangular yellow spots, and the wings less irrorated with grey; the secondaries also without paler submarginal spots, but with a zigzag black line on and between the veins towards the apex; no distinct apical border, but six large marginal black spots. Below the wings are bright golden orange or very bright ochreous yellow, with the inner border of the primaries lemon-yellow; three large black discal spots (as in the preceding species), two blackish dots on the radial interspaces, and two brownish dots on the costa; a black discocellular spot, with a yellow pupil; costal margin and fringe rose-red: secondaries with costal margin and fringe as in the primaries; a discal arched series of indistinct plum-coloured dots, beginning on the costa with a spot of this colour; a silver spot at the end of the cell with plum-coloured margin and orange zone, and above it a similar but very minute and fusiform spot; venter somewhat whitish, legs rosy. Expanse of wings 2 inches 2 lines.

♀. Larger than the male; the basal area more densely irrorated with greenish grey: secondaries densely irrorated with greenish grey, the orange spot very large and dark; marginal black spots diffused inwardly, the first two confluent; a submarginal series of irregular yellow spots bounded internally by an arched series of heavy black lunules. Under surface exactly as in the male. Expanse of wings 2 inches 8 lines.

Albino ♀. Above with the ground-colour creamy white, the primaries bluish grey towards the base; marginal spots obsolete, otherwise as in the ordinary form: secondaries densely irrorated with grey, hardly greenish, the marginal black spots united into a border, the submarginal spots fairly regular, internally bounded by blackish spots, but only very distinctly towards the costa; orange spot rather paler than in the ordinary female. Primaries below with only the apical area and a suffusion over the discoidal area of the same golden ochreous colour as in the male; the rest of the primaries creamy white, but with the usual markings; costal margin and fringe red: secondaries as in the ordinary form, excepting that the discal dots are larger. Expanse of wings 2 inches 5 lines.

This is a fairly common species, which may be readily distinguished by the deep coloration of the under surface.

Papilio nicconicolens, sp. n.

Very near to *P. helenus*, but constantly differing in the creamy-yellow patch of secondaries being carried below the radial vein in the form of a large squamose spot, and in the submarginal lunules on the under surface of the same wings being far more arcuate. Expanse of wings 5 inches 3 lines.

Papilio tractipennis, sp. n.

♂. Intermediate in size between *P. macilentus* and *P. demetrius*; similar to the latter, from which it differs in its greater size, its more elongated wings, longer and broader tails, also in the greyer tints of the primaries, upon which the black outer border appears more prominently; below the primaries are distinctly paler and greyer, the markings upon the secondaries are brighter in colour, redder, and there is an abbreviated additional red fasciole, bounded below by an arcuate streak of blue scales, across the first median interspace. Expanse of wings 5 inches 2 lines.

♀. This is the *P. demetrius* of Gray (nec Cramer); but when fresh this sex is nearly as dark as the male, although browner in tint, and with two ocellated and several submarginal lunate red markings on the upper surface of the secondaries: as usual, it is broader in wing than the male, and the tails are shorter. Expanse of wings 5 inches.

A tolerably common form, which may possibly prove to be a seasonal variety of *P. macilentus*; but until this species can be reared, it must necessarily be separated as a distinct species. The examples of *P. macilentus* taken by Mr. Maries are much worn.

Papilio spathatus, sp. n.

Possibly a seasonal form of *P. alcinous*; the latter species, however, was not obtained in Niphon by Mr. Maries; he obtained shattered males and a single fine female in Yesso; it is therefore more probable that this is a local representative of *P. alcinous*. It differs in its considerably greater size, much longer and more spatulate tails, in the heavier black borders and veins on the female, in the much obscured red submarginal lunules on the upper surface of the male secondaries, and the broader and dingier submarginal curved spots on the female secondaries. Expanse of wings, ♂ 4 inches 1 line, ♀ 4 inches 10 lines.

This is a commoner species than *P. alcinous*, which (owing to the fact that Klug erroneously figures its female as that sex of his species) it generally represents in collections. *P. alcinous* ♀ agrees with the male in size and form.

In Yesso Mr. Maries caught the female of a species which in 1862 we received the male of from Hakodaté. It is allied to *P. mencius* of Felder (males of which Mr. Maries obtained at Kiukiang, China); but the wings are darker, the tails on the secondaries are more slender, the submarginal lunules are absent from the upper surface of the male secondaries, and are less arcuate and smaller upon the upper surface of the female. To this species I give the name of *P. hæmatostictus.*

Pamphila herculea, sp. n.

Allied to *P. sylvanus*, considerably larger; the male of a clearer, more ochraceous colour above, and on the under surface of a more uniformly tawny colour; the secondaries not yellowish, as in *P. sylvanus*; pattern similar. Expanse of wings 1 inch 7 lines.

♀. Above bronzy brown or chocolate-brown, with cupreous reflections: primaries with a yellow dot just above the basal third of submedian vein; a cuneiform spot filling the base of the first median interspace; a bifid spot at the end of the cell; a series of five quadrate spots, excised in front, crossing the disk obliquely from submedian to upper radial vein, and a trifid spot across the subcostal branches, halfway between the cell and the apex, buff: secondaries with an angular discal series of five ochreous spots. Wings below with the markings paler than above, the spots creamy whitish or pale bone-yellow; disk of primaries round the borders of the oblique series of spots olive-brown; external angle and outer border whity brown: secondaries bronzy olive-brown, the discal series consisting of six spots; anal angle broadly ochreous; outer border tinted with ochraceous; palpi white; body below bluish grey. Expanse of wings 1 inch 7½ lines.

One pair only was obtained.

Daimio Felderi, sp. n.

Dark brown, with white markings: primaries exactly as in *D. tethys*: secondaries crossed by a white belt, which passes through a nearly complete circular series of black spots; anal three fourths of fringe and four marginal spots white: posterior margins of abdominal segments white. Base of secondaries and body below bluish grey. Expanse of wings 1 inch 6 lines.

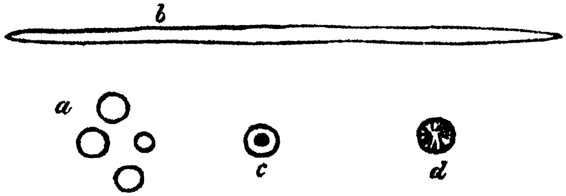
A tolerably common species; its position is between *D. tethys* and *D. sinica* of Felder; it appears to represent the latter in Japan, and differs from it in the smaller spots on the primaries, and in the black spots being visible upon the white belt of the secondaries.

XIII.—*Note on the Occurrence of Sponge-spicules in Chert from the Carboniferous Limestone of Ireland.* By Prof. W. J. SOLLAS, M.A., F.R.S.E., &c.

ON studying the beautiful microphotographs of sections of chert figured in Prof. Hull's valuable paper "on the Nature and Origin of the Beds of Chert in the Upper Carboniferous Limestone of Ireland" *, it appeared to me that in some of these photographs traces of sponge-spicules could be seen. On communicating my opinion to Prof. Hull, he most obligingly sent me five of his mounted sections of chert for microscopical examination. For this act of kindness I now offer him my best thanks.

The results of my examination of the slices were, in the first place, to completely confirm his clear descriptions of the appearances presented by them, and, next, to establish the truth of my supposed detection of sponge-spicules. The slides are numbered C 22 (fig. 4 in Prof. Hull's memoir), C 23, C 24, C 25 (fig. 1 in the memoir), and C. 41. In the first four a number of clear spaces with definite circular outlines (fig. 1, *a*) 0·008 inch in diam. were clearly visible, and also a number of long, straight, parallel-sided bands (*b*) of the same breadth as the diameter of the circles. The bands are longitudinal, the circles transverse, sections of sponge-spicules, and are exactly similar to those with which I am from long acquaintance familiar in the flint and chert of other localities.

Fig. 1.



Sections of sponge-spicules in Carboniferous chert: *a*, transverse; *b*, longitudinal; *c*, transverse, showing axial canal; *d*, showing radiately crystalline structure. (Magnified 50 diameters.)

The transverse sections frequently show a central dark spot (*c*), the remains of the axial canal; and in both directions of section a radiate crystalline structure (*d*), such as I have often observed and recently described in loose fossil spicules, is apparent with polarized light.

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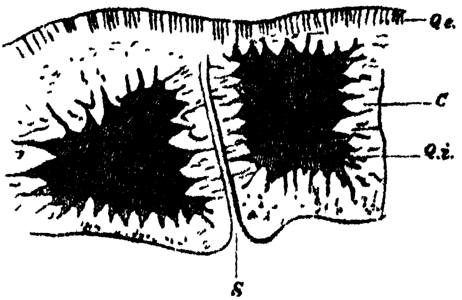
* Sci. Trans. Roy. Dublin Soc. vol. i. n. s., p. 71, pl. iii.

Of slices C 22 and C 23 it may be safely said that the chief determinable constituents are sponge-spicules; they make up the larger part of the chert.

Rhombohedra of dolomite, precisely similar to those described by Prof. Renard in his paper on the Carboniferous Phthanites*, are also to be seen in most of the sections. The presence of these crystals can readily be explained in accordance with the theory of the formation of flint lately advocated by me. It is well known that most limestones contain a trace of magnesian carbonate, probably in the form of dolomite. This is very much less soluble in acids than calcite, so that it is left as a residue on dissolving limestone in dilute hydrochloric acid. The silicic acid which dissolved and replaced the calcic carbonate would therefore act with greater difficulty on the dolomite, and, indeed, would in all probability have no action upon it at all; and so, while the mass of the limestone underwent silicification, the rhombohedra of dolomite would remain unaltered in the midst of the chert, just as we now find them.

That the formation of the chert continued, if it did not commence, some time subsequent to the formation of the limestone is proved by a curious fact observable in the section of coral shown in the centre of the section represented in fig. 1 of Prof. Hull's plate. Some of the vesicular spaces at the edge of this are completely lined by crystals of calcite (dog-tooth spar) which has not undergone silicification, while the interior of the spaces is occupied by crystalline grains of quartz (fig. 2).

Fig. 2.



Part of section of coral from chert (fig. 1, pl. iii. Hull's paper): *Q e*, external wall, consisting of radiating crystalline fibres of quartz; *S*, septum; *C*, calcite lining marginal vesicle; *Q i*, quartz within the vesicle. (× 60 diam.)

It is clear that the coral had been dead and exposed to the

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[*] Bull. de l'Acad. roy. Belg. 2ᵉ sér. t. xlvi.

action of surrounding waters long enough for a deposit of calcite to be formed within the marginal vesicles before the infiltration of silica occurred.

Of the section of chert labelled C 41 I could make but little; it appeared to contain clastic granules of quartz.

XIV.—*Recent Dredging by the United-States Fish Commission off the South Coast of New England, with some Notice of the Crustacea obtained.* By S. I. SMITH.

THE United-States Commission of Fish and Fisheries, under the direction of the Commissioner, Professor Baird, with headquarters at Newport, Rhode Island, has had increased facilities for scientific work the past season, and has added even more than in past years to the knowledge of our marine fauna. The new steamer 'Fish Hawk,' of 480 tons, built for the work of the Commission, and under the command of Lieut. Tanner, U.S.N., is specially fitted for scientific work, and was employed a large part of the season in trawling, dredging, and in making temperature observations. The investigation of the invertebrate fauna, as in previous years, was carried on by a party under the general direction of Professor Verrill, of Yale College. Large collections were made in the shallower waters along the coast and also on the shores; but the most interesting results were obtained from a series of trawlings and dredgings made in September and the first week in October, on three trips 75 to 100 miles off the coast, in the region known as the Block Island Soundings. A general account of these trips is given by Prof. Verrill in the 'American Journal of Science' for November (vol. xx. pp. 390–403), and need not be repeated here, further than that the region examined is in north lat. 39° 46′ to 40° 06′, west long. 70° 22′ to 71° 10′, that on each trip the dredging and trawling occupied less than a day's time, and that twenty-two hauls of the dredge and trawl were made from depths varying from 64 to about 500 fathoms. Wire rope was very advantageously employed in all the dredging and trawling. At one station, 86 fathoms, the bottom was covered with shells and sponges; but at all the other stations it was composed of fine sand and mud.

The collections have not been fully examined; and this is specially true of the collections from the deepest water which were made on the last trip. But the wonderful richness of the fauna in mollusks and echinoderms has been shown by Professor Verrill in the paper already referred to; and it is certainly not less remarkable as regards the crustaceans. The richness of the fauna in both species and individuals would never have been suspected by one accustomed only to the meagre fauna of the shallow waters of the south coast of New England.

In regard to the mollusks and echinoderms, it is here sufficient to quote a few sentences from Professor Verrill's article. He says:—"Of Mollusca about 175 species were taken. Of these, 120 species were not before known to occur on the southern coast of New England; about 65 are additions to the American fauna; of these about 30 are apparently undescribed. The known species now added to our fauna have mostly been described by G. O. Sars, Jeffreys, and others from the deep waters of the European coast and the Mediterranean." "The Starfishes and Ophiurans were exceedingly abundant and beautiful at all the stations; and many species not known previously on our coast were taken, several of which appear to be undescribed, while others were known only from Northern Europe or from the deep waters off Florida. Many of the species have only recently been obtained from the northern fishing-banks off Nova Scotia. One new species of *Archaster* (*A. americanus*) was particularly abundant, several thousands of specimens having been taken; but the two largest and most beautiful species of this genus were *Archaster Agassizi* (new) and *A. Floræ*. Of *Odontaster hispidus* over 100 were taken." There are thirty-two species in the partial list of echinoderms given, four of which are described as new.

A preliminary notice of the Crustacea obtained from this interesting region is now in type for the 'Proceedings of the National Museum' for 1880 (pp. 413–452); and I here give only a very brief statement of the most interesting results there brought out, with full descriptions of the new forms.

Among the Brachyura were *Hyas coarctata*, *Cancer borealis*, and *Geryon quinquedens*, which were known from further north; but with these there were *Collodes depressus*, *Euprognatha rastellifera*, *Bathynectes longispina*, and *Acanthocarpus Alexandri*, species previously known only from the Straits of Florida. There were also new species of *Ethusa* and *Lambrus*, genera quite new to our waters. The *Euprognatha* occurred in the greatest abundance at nearly every station, many thousands of specimens often being taken at a single haul.

Among the Anomura occurred *Homola barbata* and *Latreillia elegans* (which represent families heretofore unknown on this side of the Atlantic), a beautiful species of *Lyreidus*, De

Haan (a genus before known only from the North Pacific), and a species of *Munida.* These were associated with *Eupagurus bernhardus*, *E. Kröyeri*, and the remarkable *Parapagurus pilosimanus*, which were before known from the north. But the most interesting Anomura were two species of a new genus (*Hemipagurus*), allied to the little-known genus *Spiropagurus*, Stimpson, but differing conspicuously in the form and position of the single sexual appendage of the last thoracic somite of the male, which arises from the coxa of the *right* side, while in *Spiropagurus* it arises from the *left* side. Both the species of *Hemipagurus* inhabit cases formed by a colony of *Epizoanthus* or by an individual of a species of *Adamsia.*

The unsymmetrical development of the external sexual organs of the males of this genus is accompanied by a most remarkable difference in the corresponding internal organs. The abdominal viscera are not sufficiently well preserved in the ordinary alcoholic specimens for a full anatomical and histological investigation; but the following observations, though incomplete, are so novel and interesting that I insert them here. The right testis and vas deferens are much larger than the left. The lower part of the right vas deferens, in all the adults examined, is much more dilated than the left, and is filled (as is also the external part of the duct) with very large spermatophores of peculiar form. The left vas deferens is slender, much as in *Eupagurus bernhardus*, terminates in a small opening in the left coxa of the last thoracic somite, as in ordinary Paguroids, and contains spermatophores somewhat similar in form and size to those of *Eupagurus bernhardus.* In alcoholic specimens of the larger and more abundant of the two species, the spermatophores from the left vas deferens are approximately 0·16 millim. long and 0·035 millim. broad, with a slender neck about a third of the entire length, and a very thin and delicate lamella for a base. The spermatophores from the right vas deferens are over 2 millims. in total length; the body itself is oval, approximately 0·40 millim. long and a third as broad; at one end it terminates in a very long and slender process, two or three times as long as the body; at the other end there is a similar but slightly stouter process, a little longer than the body, and expanding at its tip into a broad and very delicate lamella, approximately 0·35 millim. long by 0·20 millim. broad. The contents of the two kinds of spermatophores are, of course, not in a condition to show the structure of the spermatozoa; but they present a similar appearance in each case, and are apparently of about the same size.

he most interesting of the Macrura is, perhaps, a new species of *Nephropsis*, very closely allied to *N. Stewarti*, Wood-Mason, heretofore the only known species, which was described from a single specimen dredged in the Bay of Bengal and wanting the great claws. These claws, in our specimens, are clothed with very long soft hair, and are very different from the great claws of *Nephrops*, though the genus is very closely allied to *Nephrops*, as pointed out by Wood-Mason. The number and arrangement of the branchiæ, not noticed in the description of *N. Stewarti*, are the same as in *Nephrops*. There were also new species of *Arctus*, *Axius*, *Pontophilus*, *Bythocaris*, *Pandalus*, and *Penæus*, and with these the following arctic species—*Pontophilus norvegicus*, *Pandalus propinquus*, *Hippolyte securifrons*, and *Sergestes arcticus*, the last species being common in 300 to 500 fathoms.

Among the Schizopoda were three arctic species, *Thysanopoda norvegica*, *Pseudomma roseum*, and *Boreomysis arctica*, the last heretofore known to America only from Greenland.

The only Stomatopod was a new species of *Lysiosquilla*, which appears to be closely allied to *L. spinosa*, from the Indian Ocean and New Zealand, or at least much more closely allied to this than to any other species described in Mr. Miers's recent review of the Squillidæ.

Few species of Amphipoda were found; but the arctic species, *Stegocephalus ampulla*, *Haploops setosa*, and *Epimeria loricata*, G. O. Sars, occurred, the last in abundance.

Among the Isopoda there were four species previously known only from further north on our coast, and *Mounopsis typica*, a deep-water species known from our northern coast, Greenland, and Northern Europe. There were besides several species not determined.

Fifty species of Malacostraca are enumerated in the preliminary notice above referred to; and of these fourteen are described as new and three others are indicated as probably new, forty-three are first recorded as belonging to the New-England fauna south of Cape Cod, twenty-eight are new to the whole fauna from Cape Hatteras to Northern Labrador, and twenty-one are new to America including Greenland. Of the forty-three species new to the Southern New-England fauna, fifteen are now known also from the New-England fauna north of Cape Cod; and of the remaining twenty-eight, four were already known from the Straits of Florida, three from Greenland and Northern Europe, and two from the Mediterranean. It should be added that two of the species, the *Lyreidus* and the *Nephropsis*, belong to genera heretofore known only from the Pacific region, and each represented there by a single species, while a third species, the *Lysiosquilla*, has its nearest known ally in a species from the same region.

New Haven, Conn., U. S. A.,
Dec. 20, 1880

XV.—*Contributions towards a General History of the Marine Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. vi. p. 384.]

[Plates VIII., IX., & X.]

IV. FOREIGN MEMBRANIPORINA (second series).

a. With a membranous front wall.

Membranipora coronata, n. sp.
(Pl. X. fig. 1.)

Zoœcia lozenge-shaped, contiguous; area occupying the whole front, with a membranous covering; margin not much elevated, except round the oral extremity, where it rises into a hood-like screen, projecting slightly over the area and hollowed out in front into an arch; inner surface of the cell-wall very strongly crenated and granulated; immediately above each zoœcium an immersed *avicularium* with acute mandible, placed transversely. *Oœcium* (?). *Zoarium* white and shining.

Loc. Singapore or the Philippines, on coral (*Miss Jelly*).

The striking features of this pretty species are the crowning avicularium, the very marked crenation of the border of the cells, and the glossy whiteness of the whole zoarium.

Membranipora terrifica, n. sp.
(Pl. VIII. fig. 5.)

Zoœcia large, somewhat pyriform, arched above, widest in the middle, narrowing off below the area; area broad below, slightly contracted towards the top, with a membranous covering, occupying about two thirds of the front of the cell; margin not much elevated, thin, smooth; the wall of the cell below the area dense, uneven, punctured; placed transversely along the whole of the lower margin of the aperture, and projecting prominently on the subjacent space, a gigantic *avicularium*, with long, narrow, curved beak, the basal portion much expanded, with an angular projection on each side in the line of the hinge; mandible (probably) slender and setiform.

Loc. Straits of Magellan, on *Eschara flabellaris*, Busk (*Miss Gatty*).

Membranipora rubida, n. sp.
(Pl. VIII. fig. 6.)

Zoœcia somewhat pyriform, arched and expanded above, below the area narrowing rather abruptly downwards; area suborbicular, the covering wholly membranous, occupying about three fourths of the front of the cell; margin much raised round the sides and upper portion of the cell, thin, smooth, two spines on each side of the orifice, the foremost pair very tall and stout; zoœcium prolonged slightly below the area, and on this portion is situated an *avicularium* borne on the summit of a stout and rather tall peduncle, from the lower part of which two spines often project, mandible acute, directed downwards; sometimes replaced by a linguiform avicularium, slightly pedunculate, placed transversely. *Zoarium* of a reddish-brown colour.

Loc. Australia, on stone (*Miss Gatty*).

The prolongation of the cell below the area is often small and inconspicuous; but its position is indicated by the stalked avicularium which is always placed upon it. The peduncle of this appendage, which is of remarkable length, seems to consist of two parts—a short tubular base, which frequently bears two spinous processes, and is permanently attached to the cell, and a much longer cylindrical stem, on which the avicularium is supported; the latter is easily detached, and seems to be jointed in some way or other to the fixed basal portion. The structure is interesting, as showing a modification in the direction of the higher articulate forms.

Membranipora bicolor, n. sp.
(Pl. IX. fig. 1.)

Zoœcia oblong, narrow, alternate, very regularly disposed in lines, the whole front filled in by a membranous wall, at the very top of which is the opercular valve; margin thin and smooth; the zoœcia in each line separated by elongate spaces, usually rather less than the cell in length, which are covered in by a white calcareous roofing, terminating at one extremity in an arch, with a somewhat thickened rim, which incloses the orifice of the cell below, and at the other more or less hollowed out, the depression extending to the base of the cell above. No spines or *avicularia*.

Loc. West Australia, spreading over weed (*Miss Jelly*).

The elongate calcareous boxes interposed between the cells in this species might naturally be taken for oœcia; but they are closed in at the end by a calcareous wall, in which there seems to be no opening beyond some minute perforations. They have probably, therefore, some other significance; but what it may be I am unable at present to determine. The zoœcia are really of a slender, elongate-oval shape, though they sometimes appear quadrangular. The membranous front wall extends to the top of the hollow or depression in the neighbouring interspace, and lies quite on a level with the rim of the margins.

Membranipora bellula, n. sp.
(Pl. VIII. figs. 4, 4*a*, 4*b*.)

Zoœcia pyriform, rounded and expanded above, and narrowing off to the base; area occupying about half the length of the cell, wholly filled in with membrane, subelliptical, broad below and narrowing very slightly upwards to the top, where the semicircular orifice is placed, flanked on each side by two tall erect spines; on the lower margin a single, much-branched spine, which spreads over the aperture, forming an antler-like operculum; sometimes a very long corneous spine, springing from a raised socket, a little below the inferior margin; portion of the cell below the area, which is sometimes a good deal elongated, smooth and shining, and covered with numerous delicate spinules. *Oœcia* none.

Var. *a* (*bicornis*). With two opercular spines on the lower margin, of small size and slightly branched, placed one on each side of a short, sharply pointed central mucro rising from a prominent boss; a single spine only on each side of the orifice; no spinules or horny appendages; surface smooth, white, and very polished.

Var. *β* (*multicornis*). Opercular spines 3–5, placed closely together, their numerous dichotomous branchlets combining to form a beautiful protective shield, which extends to the base of the oral valve.

Loc. Australia, normal and var. *multicornis*; Ceylon, var. *bicornis*; Madagascar (*Miss Jelly*); St. Vincent, Cape-Verd Islands (*Miss Gatty*). *M. bellula* always occurs creeping over weed, and frequently runs out into narrow strap-like segments.

This is an exquisite species, which seems to be far from uncommon in various parts of the world; and it is difficult to understand how it is that it has remained so long undescribed. I cannot recollect, however, to have met with any published account of it, although it has been known to collectors under a manuscript name. It is a species which varies much in appearance, the changes being chiefly due to the presence or absence of the spinous appendages, and especially to the modification of the opercular spine. The principal varieties have already been noticed. In some cases the tall corneous spine rising from a distinct socket, which is so characteristic of *M. pilosa* (from which the present form is probably derived), makes its appearance; in others the zoarium bristles with immense numbers of slender spinules; in others, again, it has neither seta nor spinule. In a curious form from Madagascar the edges of the narrow segments into which the zoarium divides are fringed by very tall and slender setæ, frequently placed in pairs, whilst there is also a profusion of the suboral appendages. This form presents a very marked contrast to the extremely simple and elegant variety (*bicornis*) from Ceylon. The same variability in the spinous armature is characteristic of *M. pilosa*.

b. With a calcareous lamina.

Membranipora patula, n. sp.

(Pl. IX. fig. 4.)

Zoœcia short, narrowed above and broadly expanded below, the upper extremity of the cell much raised, the lower depressed; margin well raised, narrow, sharp, minutely granulated; aperture arched above, the lower margin slightly curved outwards, occupying fully three fourths of the length of the area, the lower fourth filled in by a strongly granulated, calcareous lamina, which is continued for a short distance up each side; on the upper margin four very stout cylindrical spines, two towards each side, which are articulated by corneous joints; projecting from the centre of the back of the cell, some way below the margin, an *avicularium* with pointed mandible, directed straight outwards. *Oœcium* (?).

Loc. California (*Miss Jelly*).

Membranipora setigera, n. sp.

(Pl. VIII. fig. 3.)

Zoœcia large, ovate; area occupying the whole front of the cell, the lower two thirds covered in by a shining calcareous lamina, minutely pitted over; aperture arched above, lower margin straight, closed by a rather stout membranous wall, at the upper extremity of which is the orifice; margin not much raised, granulated; a row of 6–8 tall spines surrounding the upper extremity of the area. *Avicularia* none. *Oœcium* (?).

Loc. Australia, investing *Serpula* (*Miss Gatty*).

This species belongs to the same section of the genus as our British *M. Rosselii* and *M. trifolium*. Its spines are a conspicuous character, the zoarium literally bristling with them. The surface is flat and somewhat glistening.

Membranipora spinosa, Quoy & Gaimard.

Flustra spinosa, Q. & G., Voy. de l'Astrolabe.
Membranipora ciliata, MacGillivray, Trans. Roy. Soc. Victoria, 1868.
Membranipora spinosa, Busk, Polyzoa of Kerguelen Island.

Busk identifies a form from Kerguelen Island with the

Flustra spinosa of Quoy & Gaimard; and from the figure which he gives it would seem to be the same as the *M. ciliata* of MacGillivray, an Australian species. If he is correct in his identification, the latter name must give place to that of Quoy and Gaimard.

The species has occurred in the following localities:—Kerguelen Island (*Mr. Eaton*); Australia (*MacGillivray*); Arabian Sea, between Bombay and Aden, lat. about 15° N., long. about 65° E. (*W. Oates*).

Another *Membranipora spinosa* has been described by D'Orbigny (Voy. dans l'Amér. Mérid. vol. v. 4e partie), which bears a close resemblance to *M. spinifera*, Johnston, but is apparently destitute of avicularia. It is furnished with about 10 spines on each side of the cell.

Membranipora permunita, n. sp.
(Pl. X. fig. 2.)

Zoœcia arched above, expanding very slightly towards the centre, and then narrowing off more or less to the base, which is subtruncate; area occupying the whole of the front of the cell, the lower two thirds filled in by a strong, thickly-granulated, calcareous lamina; aperture arched above, lower margin straight, higher than broad, margin scarcely elevated, very finely beaded; scattered amongst the zoœcia elongate, narrow-oval cells, the lower part of which is occupied by an *avicularium*, depressed at the base, the beak much raised, turned obliquely to one side, somewhat curved and pointed; mandible slender, edged on each side by a horny expansion; upper portion of avicularian cell hollow and open. *Oœcia* rounded, closely united to the lamina of the cell above, with a raised rib round the front, inclosing a minutely granulated space.

Loc. Off Curtis Island, Bass's Straits, common on shell (*Capt. W. H. Cawne Warren*).

This species occurs in a very interesting collection of Polyzoa made by Capt. Warren, of the ship 'Bedfordshire,' and presented by him to the Liverpool Free Museum. The committee of the Museum, at the instance of its very able and energetic curator, Mr. Moore, have entrusted the collection to me for examination; and I hope to describe and figure a number of new forms from it in subsequent papers.

M. permunita is interesting as being one of the few recent species belonging to the present section of the genus which are furnished with an avicularium of the elongate type placed on a well-developed cell-area. A very similar appendage occurs on *M. curvirostris*, mihi; and it is not uncommon amongst the species with a membranous front wall.

Membranipora (*Caleschara*) *denticulata*, MacGillivray*. (Pl. VIII. fig. 2.)

Zoarium foliaceous, with the cells in two layers placed back to back, or incrusting. *Zoœcia* arched above, widening about the middle, and contracted below; margin smooth, sometimes traversed by a brown line, inner side of the cell-wall granular; area occupying the whole front of the cell, the lower one third filled in by a granulated calcareous plate; a transparent membranous wall extending over the entire area, including the calcareous plate, the oral valve being placed at the very top of it; from the centre of the upper edge of the lamina rises a broad calcareous process (also granulated), which extends to about one third the length of the aperture from the top, where it sends off two lateral branches to the wall of the cell, forming in this way a foramen on each side, the inner edges of which are denticulate; the upper margin of the process is slightly thickened, and shuts off a semicircular space above, corresponding with the operculum in the true front wall; at the bottom of each cell one or sometimes two rather large smooth nodules. *Oœcium* wide, little projecting, incorporated with the cell above, both the ovicelligerous cell and the one above it of unusual size (*MacG.*).

Loc. Victoria (*MacGillivray*): off Curtis Island, Bass's Straits, on shell, forming a brown subcircular patch (*Capt. Cawne Warren*).

MacGillivray places this species among the Escharidæ (Busk), simply, it would seem, on the ground of its erect habit. It has, in truth, no real affinity with this family as constituted by Busk. The depressed area, the elevated margins, and the membranous front wall show that its place is amongst the Membraniporidæ. Nor is there any sufficient ground, in my judgment, for referring it to a new genus. The peculiarity on which MacGillivray founds his *Caleschara* ("front calcareous, except a small part anteriorly, which is membranous") is, I believe, quite insignificant. I venture to think that he has misinterpreted the structure of the zoœcium, probably owing to the imperfect condition of the specimens which came under his notice. The "front" of his description is not the true front wall of the cell, but merely a calcareous upgrowth from the edge of the lamina (strictly comparable with the "serrated denticle," similarly placed in *Membranipora* (*Biflustra*) *delicatula*, Busk); and the membranous portion at the upper extremity is only occasional, and merely denotes imperfect development. That *the true upper wall of the zoœcium* is the membrane which closes in the whole of the area is evident from the course of development and from the fact that it bears the oral valve. In the younger zoœcia the laminar process is either wholly wanting or very imperfectly developed, whilst the membranous wall, furnished with the semicircular orifice for the egress of the polypide, occupies the whole of the opening *at a considerable distance above the lamina.*

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* 'Prodromus of the Zoology of Victoria,' decade v., by Fred M'Coy, F.R.S; 'Polyzoa,' by P. H. MacGillivray, p. 45, pl xlviii. fig. 8

The real peculiarity of this form is that the membrane incloses the granular plate and its process; but this, however curious, is hardly a generic character. The same thing occurs in a less degree in *M. nitens*, mihi. As to the habit of growth, MacGillivray's figure represents a small erect and foliated specimen; the one from Bass's Straits is wholly crustaceous. Another which I have examined grows round a stem of seaweed, and the free edges meeting on one side of it come together and unite; and in any further growth at this point there would be a bilaminate structure, and the zoarium would become erect and detached; but it would be none the less a *Membranipora.* The large nodules at the base of the cells, which were present in the specimen I have figured, materially change the general appearance of the species.

Membranipora cervicornis, Busk[*].
(Pl. VIII. fig. 1, and Pl. X. fig. 3.)

Zoœcia oval; margin much raised round the upper part of the cell, forming a very thin wall, which also extends for some distance down the sides; area occupying the whole of the front, about a third of it filled in by a smooth and shining calcareous lamina, which is carried up for some distance on each side; aperture flattened above, narrowing downward, rounded at the lower extremity (very much in the form of a heraldic shield), surrounded by a slightly thickened rim; at the top of the cell four spines, placed two on each side, the foremost pair stout, suberect, and branched, like a stag's horn, the upper tall, slender, and slightly forked; between them a raised *avicularium* with pointed mandible, placed transversely on the margin of the cell, or projecting straight outwards from the back; frequently a large raised *avicularium* at the bottom of the cell. *Oœcium* very shallow, galeriform, smooth, the oral surface much sloped, so as to expose the opening; a raised line arching across the front a short distance above the opening, inclosing a narrow subhyaline belt; an avicularium on the summit, placed transversely; two spines in front of the ovicell, and two at the sides (Plate VIII. fig. 1). *Zoarium* white or brownish, or of a rather deep purplish colour.

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[*] There has been some doubt whether the *M. cervicornis*, Busk (Cat. pt. 1, pl. c. fig. 3), is identical with the form described by MacGillivray under this name. Busk's figure does not show the detail of the zoœcium very clearly; but the branching spines, as he represents them, are certainly different from the similar appendages as given by MacGillivray. They are massive and spreading, and bend in over the area, the branches "meeting and inosculating;" whereas in the other form they are erect and comparatively slender, and show no tendency to unite across the cell. The colour also of Busk's species is said to be "purplish;" that of the Australian species white or brownish. Amongst Capt. Warren's dredgings, however, from Bass's Straits, I have met with specimens undoubtedly referable to MacGillivray's species, in which the spines are somewhat more massive, and occasionally meet and (apparently) unite across the cell; they are also of a deep purplish colour.

Var. *a.* *Oœcium* much deeper (less shallow), almost subquadrate, the oral surface not sloped; a raised rib in front inclosing a subtriangular space; one or two avicularia at the back (Pl. X. fig. 3).

Loc. Victoria (*MacGillivray*); var. *a*, off Curtis Island, Bass's Straits (*Capt. Cawne Warren*).

I have thought it desirable to give a detailed description of this species, as MacGillivray has contented himself with a very brief diagnosis. Busk's account of his *M. cervicornis* is almost equally brief; and between the two there is some difficulty in deciding with any certainty as to the identity or otherwise of the two forms.

The differences in the oœcium are striking and curious; but they can only be regarded as varietal. The spines are articulated to a fixed tubular base, and are easily detached; in their absence it is somewhat difficult at first sight to recognize the species.

Note on *Membranipora transversa*, Hincks.

When I described this form ('Annals,' July 1880) I was not aware that Mr. Hutton had been before me. I had not then seen his paper in the 'Proceedings of the Royal Society of Tasmania' for 1877 (published in 1878), in which he has characterized it as *M. cincta.* Of course the name *transversa* must be cancelled; and I can only hope that it may drop out of sight and give no further trouble.

In a paper presented to the Royal Society of Victoria early in 1880 Mr. MacGillivray has given a fuller account of the same species, and proposes to refer it to a new genus, which he names *Diplopora*, and of which the distinctive characters, seem to be that the zoœcium is divided into two parts, and that "a narrow transverse portion" of the front cell-wall, "a little distance behind the mouth and in front of the elevated part," is deficient in calcareous matter and entirely membranous. On reexamining my specimens I find that a membranous wall closes in the whole of the aperture, bearing the oral valve at the upper extremity, and extending almost to the top of the elevated portion of the cell. Beneath the oral valve is an elliptical orifice with calcareous margin filled in with membrane and having a circular opening in the centre; from the edge of this inner orifice a calcareous wall passes down to a fissure extending transversely across the cell, and probably marking the termination of the true zoœcium. Below the fissure is the wall of the elevated part of the cell, which is a strong box. Towards the base of this wall a tubular process projects into the fissure, probably forming a communication between the box and it. The precise significance of this structure can only be determined by an examination of living specimens; but it seems to form a good basis for a new generic group.

One curious peculiarity of this species should be noted. The colonies, which always seem to encircle the stems of certain algæ, commence with a (transverse) row of elongated, narrow, quadrangular cells, having the front entirely closed in with membrane, destitute of orifice, and of all the characteristic structure of the adult; this row is followed by a second, in which the cells resemble generally those in the first, but are much shorter; and from these the normal zoœcia originate.

Family **Microporidæ.**

Genus VINCULARIA (part), Defrance.

Vincularia abyssicola, Smitt.

(Pl. X. fig. 4.)

This form I had figured from a specimen incrusting a small fragment of coral, as (probably) a new species of *Setosella*; and only ascertained subsequently that it was identical with *Vincularia abyssicola* of Smitt. I mention this to show how essentially Membraniporidan the zoœcial character of this generic type is; in its incrusting state it is impossible to distinguish the present species from *Setosella*. Whether its peculiar habit of growth in the adult state (the zoœcia are arranged so as to form erect, cylindrical stems like those of *Cellaria*, but unjointed) entitles it to generic rank is a question to which different answers may be given; but *we in*

its true natural affinities (and this is the important point) by ranking it in the family of the Microporidæ.

Vincularia ornata, Busk, and *V. neozelanica*, Busk, are true Membraniporidæ.

I have engraved the figure of *V. abyssicola*, as it shows a finer development of the remarkable vibracula than Smitt's. These appendages exhibit a very interesting structure, being edged for a considerable portion of their length along both sides by a rather broad membranous expansion.

Loc. Off Cojima, Cuba, 450 fathoms, on *Retepora*; Florida, 68 fathoms, on *Nullipora* (Pourtales); on coral from Singapore or the Philippines (*Miss Jelly*).

V. FOREIGN CHEILOSTOMATA. (Miscellaneous.)

Family **Epicaulidiidæ**.

EPICAULIDIUM, n. gen.

Gen. char.—*Zoarium* calcareous, composed of a creeping base and erect stems, made up of internodes linked together at their extremities by corneous joints, on which the zoœcia are borne in companies. *Zoœcia* erect, clavate, with a small, oblique, subterminal orifice, several united together longitudinally, so as to form a cluster; the clusters opposite, free, except at the base, where they are attached by corneous joints to the internodes.

Epicaulidium pulchrum, n. sp.
(Pl. X. fig. 5.)

Stem composed of jointed internodes of about equal length, which are white, expanding gradually from the base upwards to a point a short distance below the top, where there is a slight protuberance on each side, surmounted by a circular orifice, from which the corneous joint supporting the cluster of cells originates; above the projections the internode narrows and continues cylindrical to the top; a number of small tubules immersed in the cells, which show as disks on the surface and give it a speckled appearance; no branching. *Zoœcia* in triplets, united through their whole length, the central one compressed, narrow, pointed below, slightly wider above, orifice oval, oblique, with a thin slightly raised margin, facing towards the base of the stem (downwards); two lateral cells subclavate, expanded above, narrowed and pointed at the base, orifice as in central cell, except that there is a small spine in the centre of the upper margin; surface smooth and shining; the lateral cells attached by the dorsal surface to the sides of the central, orifice facing sideways, with a slight turn upwards; the triplets also speckled, but less strongly and constantly than the stem; form of the triplets subcordate. *Oœcia* (?).

Loc. Jamaica, creeping over an alga (*Miss Jelly*).

Amongst the taller stems occur others consisting of a very short and slender internode attached by a corneous joint to the creeping base, and bearing on its summit a single triplet. In these cases growth seems to proceed no further. The *primary internode* of the ordinary stem is jointed to the creeping fibre, and is sometimes normal and sometimes altogether destitute of cells.

Family **Bicellariidæ**.

DIACHORIS, Busk.

Diachoris bilaminata, n. sp.

(Pl. VIII. figs. 7, 7 *a*).

Zoarium (probably) erect, composed of two layers of cells placed back to back; connecting tubes six, very short. *Zoœcia* large, elongate, boat-shaped, suberect, placed close together and overlapping considerably; margin running out into a short spinous process on each side of the orifice; aperture occupying the whole front; orifice terminal; oral valve arched above, with a straight lower margin; at a short distance below the top on one side an articulated avicularium (often wanting), slender, rather compressed, the beak long and flat above, bent slightly and abruptly at the extremity; mandible very slender and sharply pointed. *Oœcia* (?).

Loc. New Zealand (*Miss Jelly*).

This diagnosis is founded on a fragment; and I can therefore give no account of the size or mode of growth. The zoœcia have a strongly marked character, and differ widely from those of any form with which I am acquainted. The layers are closely united, and constitute a very compact bilaminate zoarium. A striking point is the degree in which the zoœcia overlap one another, each cell originating a good way down on the dorsal surface of the one below it.

The affinity between *Diachoris* and *Beania* and *Bugula* is of the closest kind; between the present genus and the last named there is indeed but a single point of difference that is at all constant, the disjunct condition of the cells; and this can hardly be regarded as specially significant*.

The following species of *Diachoris* have been described:— *D. Crotali*, Busk, Bass's Straits; *D. magellanica*, Busk (=*D.*

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* I quite agree with Mr. Waters that "the genus *Diachoris* can only be looked upon as a provisional one" ("Bryozoa of Bay of Naples," 'Annals,' Feb. 1879, p. 120).

Buskei, Heller), Straits of Magellan, New Zealand, Mediterranean; *D. inermis*, Busk, New Zealand, Straits of Magellan; *D. costata*, Busk, Kerguelen Island, Australia; *D. spinigera*, Australia; *D. hirtissima*, Heller (= *Chaunosia hirtissima*, Busk), Adriatic, Cape of Good Hope; *D. armata*, Heller, Adriatic; *D. patellaria*, Moll (= *D. simplex*, Heller, and *Mollia patellaria*, Smitt—generically distinct), Adriatic; *D. Buskiana*, Hutton, New Zealand.

Family **Myriozoidæ** (part), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella argentea, n. sp.

(Pl. IX. figs. 6, 6 *a*.)

Zoœcia ovate, irregularly disposed, convex, strongly sutured, separated by inconspicuous lines, very distinctly and beautifully granulated over the entire surface, punctured round the margin, greyish white, lustrous; orifice suborbicular, produced below into a pointed sinus; peristome not raised; along one side of it a large mound-like elevation, rising to a point above, on the inner face of which is an erect *avicularium*, with acute mandible directed upwards; on the opposite side, just beyond the sinus, a short spinous process; on the upper margin two or three spines; in many cases the oral avicularium, instead of being erect and close upon the margin, is turned downwards and outwards, is much elongated, and stretches down about half the length of the cell. *Oœcia* rounded, thickly granulated and punctured. *Zoarium* of very delicate texture, greyish white, silvery.

Loc. Africa, on coral (*Miss Jelly*)

Schizoporella linearis, Hassall, form *quincuncialis*.

(Pl. IX. fig. 3.)

Zoœcia ovate, occasionally lozenge-shaped, moderately convex, separated by lines, quincuncially arranged; surface bright and silvery, thickly punctured; orifice suborbicular, with a shallow pointed sinus on the lower margin, a ridge-like callosity placed longitudinally immediately below the sinus; at each side of the orifice, usually almost close to the top of the cell, a mound-like rising, bearing a small *avicularium*; mandible acute, generally directed upwards. *Oœcium* (?).

Loc. Ceylon (*Miss Jelly*).

In general appearance this variety is very unlike the well-known *S. linearis*. Its zoœcia exhibit none of the depression of surface and definite linear arrangement which are so characteristic of the normal form; they are ovate, convex, and quincuncially disposed. But, on the other hand, the zoœcium agrees with that of the normal form in the form of the orifice, and in having a small, raised, and pointed avicularium on each side of it. These appendages, indeed, are placed somewhat higher up than is usual (more so, indeed, than is shown in my figure); but in this species there is so much variability in their position that this cannot be regarded as a character of any importance. The present form must, I think, be ranked as one more modification of the *linearis* type. I have figured another specimen of this species (Plate IX. fig. 2), which illustrates still further the variability in the position of the avicularia.

Family **Escharidæ** (part), Smitt.

SMITTIA, Hincks.

Smittia nitida, Verrill.

(Pl. IX. figs. 5, 5 *a*.)

Zoœcia subquadrangular (very irregular in shape), disposed in linear series, separated by raised lines, slightly convex, areolated round the margin, or simply punctured, the surface very bright and lustrous, of a delicate white colour, covered with large polished granules; orifice suborbicular, somewhat flattened below; the peristome raised above and (especially) at the sides, where it rises into prominent points, not elevated in front; on the lower margin three denticles, two lateral and small, and one larger in the centre; on each side of the orifice (or on one side only) a subspatulate *avicularium* (narrow at top, and expanding towards the extremity) raised on a small mound; sometimes replaced by a gigantic curved avicularium, stretching down two thirds of the length of the cell. *Oœcium* rounded, thickly punctured in front, often invested round the base by a thick granular band; usually an avicularium with pointed mandible at the back; peristome continued as an arch across the front of the oœcium.

Loc. North America (*Verrill*); Africa, on coral (*Miss Jelly*).

Drawings of this species were prepared before I was aware that it had been figured by Prof. Verrill from North-American specimens. I have engraved them, as they show a remarkable modification of the avicularium not noticed by Verrill.

A detailed diagnosis has been added, no description accompanying his figure.

ASPIDOSTOMA, n. gen.

Gen. char.—*Zoœcia* with a calcareous front wall, destitute of raised margins; orifice arched above, straight below, protected in front by a broad shield-like plate, which is continued downwards for some distance within the cell; attached to the inner surface of the plate, on a level with the margin of the orifice, a semicircular membrano-calcareous (?) frame, into which the oral valve fits; wall of the cell elevated behind the orifice into a broad hood-like expansion, which covers it in and forms an arched secondary orifice. *Zoarium* (in the only known species) erect and bilaminate.

Aspidostoma crassum, n. sp.

(Pl. X. figs. 6, 6 *a*.)

Zoarium erect, compressed, thick, contracted towards the base, and widening upwards, of a reddish-brown colour. *Zoœcia* disposed in two layers, placed back to back, massive and thick-walled, quincuncial, very broad and rounded above, narrowing off downwards (pyriform), truncate at the bottom, divided by very deep sutures; surface dense, roughened; back of the cell elevated and forming a hood over the orifice, with an arched opening in front, the margin of the hood rising into two prominent pointed processes, between which there is a narrow cleft; orifice arched above, straight below, screened by a broad plate, with a thickened and everted edge, which conceals it and stretches across a great part of the arched opening; margin of the plate continuous with the wall of the hood, and forming with it on each side a loop-shaped opening; front of the cell somewhat flattened below the orifice and sloping down towards it; in the centre of this portion a raised elongate callosity; leaning against the side of many of the cells, a little below the upper extremity, an *avicularium*, with a very short, broad, subtriangular mandible directed upwards. *Oœcium* elongate, much depressed, shield-like, granulated.

Loc. Dredged between Patagonia and the Falkland Islands (*Capt. Cawne Warren*).

This very curious form is remarkable for the thickness and solidity of the zoarium and the massive character of the zoœcia. Young cells are less strongly calcified, and the hood is of much more slender make than in the adult, and does not project so far in advance of the orifice. It is always at this stage destitute of the marginal processes which give so peculiar a character to the adult zoarium*. In the old cells calcification is carried to a great extent, the upper extremity becomes very tumid, and the wall rises down the sides into a kind of mound, which partially closes in the depressed area below the mouth. The curious structure of the orifice will be best understood by referring to the figure. The lamina or plate which protects it is hollowed out in front. This plate passes down for a considerable distance into the interior of the cell; immediately within it is placed the semicircular frame on which the oral valve works, which fits close on to the inner surface of the lamina. The flattened, shield-like ovicell is another striking feature.

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* The figures do not show the very prominent and striking character of the hood, and its two marginal processes.

The structure of the zoœcium in this species is so remarkable that I cannot hesitate to refer it to a new genus. Busk, in his 'Catalogue,' describes an *Eschara* (*E. gigantea*), from South Patagonia, which bears some slight general resemblance to the present species; but neither the diagnosis nor the figure represents the essential peculiarities of *A. crassum.*

EXPLANATION OF THE PLATES.

PLATE VIII.

Fig. 1. *Membranipora cervicornis*, MacGillivray, to show the structure of the zoœcium. The forked spines omitted, except in the case of a single cell, and only the fixed tubular base represented.

Fig. 2. *Membranipora* (*Caleschara*) *denticulata*, MacGillivray. In this figure the membranous wall, which closes in the entire front of the cell, is omitted, so as to display the calcareous lamina and the offset from its upper margin, which together form an inner covering over a considerable portion of the area. The semicircular oral valve at the top of the area must be understood to belong to the absent membranous front wall.

Fig. 3. *Membranipora setigera*, n. sp.

Fig. 4. *Membranipora bellula* (normal form), n. sp. 4 *a.* Ditto, var. *bicornis.* 4 *b.* Ditto, var. *multicornis.*

Fig. 5. *Membranipora terrifica*, n. sp.

Fig. 6. *Membranipora rubida*, n. sp.

Fig. 7. *Diachoris bilaminata*, n. sp. 7 *a.* Zoœcium with avicularium.

PLATE IX.

Fig. 1. *Membranipora bicolor*, n. sp.

Fig. 2. *Schizoporella linearis*, Hassall. Variety with avicularia at the top of the cell and on each side of the oœcium.

Fig. 3. *Schizoporella linearis*, var. *quincuncialis.*

Fig. 4. *Membranipora patula*, n. sp.

Fig. 5. *Smittia nitida*, Verrill. [This figure represents a very irregular group of cells.] 5 *a.* Zoœcium with ovicell.

Fig. 6. *Schizoporella argentea*, n. sp. 6 *a.* Single zoœcium.

PLATE X.

Fig. 1. *Membranipora coronata*, n. sp.

Fig. 2. *Membranipora permunita*, n. sp.

Fig. 3. *Membranipora cervicornis*, MacGillivray, var. 3 *a.* Oœcium.

Fig. 4. *Vincularia abyssicola*, Smitt. From an incrusting colony.

Fig. 5. *Epicaulidium pulchrum*, n. sp. 5 *a.* A single triplet of cells.

Fig. 6. *Aspidostoma crassum*, n. sp. Showing a group of cells from the younger and older portions of the colony. 6 *a.* Fragment of the zoarium, nat. size.

XVI.—*Note on a Central-Asiatic Field-Mouse* (Mus arianus). By W. T. Blanford, F.R.S. &c.

I am indebted to Mr. Oldfield Thomas for calling my attention to the fact that a Japanese species of *Mus* was named *M. erythronotus* by Temminck in 1850.

In the 'Annals' for 1875 I proposed the same name, *M. erythronotus*, for a mouse of which I obtained specimens at Kohrud, between Isfahan and Teheran, in Persia. A species apparently identical with the Persian mouse was collected by the late Dr. Stoliczka in Wakhán, a province on the Upper Oxus belonging to Afghanistan, and at Káshgar, in Eastern Turkestan; and the same form has since been found by Major Biddulph and Dr. Scully at Gilgit in the Upper Indus valley.

It is by no means certain that this form may not pass into the eastern races of *Mus sylvaticus*; and it requires comparison with *Mus sylvaticus*, var. *major*, of Radde; but as it appears to be a well-marked type, with a wide distribution in Central Asia, and as the name *Mus erythronotus* cannot be retained for it, in consequence of the prior use of the same specific denomination by Temminck, I propose to change the name to *Mus arianus*—from Ariana, one of the ancient names for Persia and the neighbouring countries to the eastward.

The following synonymy furnishes, I believe, all the necessary references:—

Mus arianus.

Mus erythronotus, W. Blanford, Ann. & Mag. Nat. Hist. ser. 4, vol. xvi. p. 311 (1875); Northern Persia, ii. p. 54, pl. v. fig. 8 (1876); Scientific Results Second Yarkand Mission, Mamm. p. 54 (1879); J. A. S. B. 1879, vol. xlviii. pt. 2, p. 97 (nec *Mus erythronotus*, Temm. Fauna Japonica, Mamm. p. 50, 1850).

Mus sylvaticus, var., W. Blanford, J. A. S. B. 1875, xliv. pt. 2, p. 106 (nec Linn.).

XVII.—*On the Origin and Formation of the Flints of the Upper or White Chalk; with Observations upon Prof. Sollas's Paper in 'The Annals and Magazine of Natural History' for December* 1880. By Surgeon-Major Wallich, M.D.

[Plate XI.]

As Mr. Sollas has seen fit to make the second part of his memoir "On the Flint Nodules of the Trimmingham Chalk" a medium for indulging in a number of unwarranted comments (for they cannot be called criticisms) upon my paper "On the Physical History of the Cretaceous Flints" (published in the 'Quarterly Journal of the Geological Society,' vol. xxxvi. No. 141, Feb. 1880)*, I shall first reply to his strictures, and then avail myself of the opportunity to furnish some additional facts and arguments in support of my views, which want of space debarred me from bringing forward in the paper just referred to.

That Mr. Sollas or any other professed geologist should have hesitated to accept my explanation as to the mode of formation of the Flints, and should freely canvass my facts as well as my conclusions, was not only perfectly legitimate, but no more than I expected when giving utterance to an hypothesis both novel and opposed, in some most important particulars, to all preconceived ideas concerning a difficult and avowedly unsolved geological problem. But I likewise expected, from a writer whose previous researches on kindred subjects (so far as I was acquainted with them) had yielded me both pleasure and instruction, at least a precise and impartial recital of such of my statements and conclusions as he felt called upon to impugn—together with some better results than a laboured and, as I venture to think, futile attempt to improve upon the well-known doctrine that "the flints are due to the replacement of carbonate of lime by silica" †.

Speaking generally, Mr. Sollas's paper contributes very little that can be considered original to our knowledge on the flint question—unless it be the interesting fact that the silica of the Trimmingham flints *may*, in part, have been derived from spicules belonging to, but now missing from, certain fossilized sponge-remains in the Trimmingham Chalk. For, although he devotes a considerable space in his paper to the chemistry of the subject, it is obvious that he has derived his inspiration, on almost every material point relating to the production of *flint*, from the splendid researches of Graham, to which, in common with myself, he appears to be indebted for whatever information he possesses regarding the colloidal properties and combinations of silicic acid and colloidal substances in general ‡. Yet he offers no explanation of the characteristic *forms* assumed by the flint nodules that may not be found in every geological textbook; and upon the most difficult and puzzling question of all (namely, the cause of the *stratification* of the flints), although he shows that he regards it as part and parcel of the Flint question, by just once (at p. 441) confessing it presents "*a* difficulty," from first to last he remains significantly silent.

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* This paper was read before the Geological Society in December 1879.

† See paper by Prof. Rupert Jones, F.R.S. &c., "On Quartz, Flint, and other forms of Silica" (Proc. Geol. Assoc. vol. iv. no. 7, Apr. 1876, p. 447).

‡ Mr. Sollas mentions Mr. Graham's name only in relation to "the fact," *if it be one*, "that silicic acid has the property of actually combining with such substances as albumen and gelatin to form with them silicate of albumen and silicate of gelatin" (*loc. cit.* p. 452).

I may observe, in reference to the last-mentioned fact, that I should have been content to discuss Mr. Sollas's theory of the formation of flint so far as it goes, and to leave entirely out of sight those points on which it would appear that he has been unable to arrive at any conclusion whatever, had he not indulged in such unjustifiable observations as the following:—"The last question which remains for discussion is the origin of the various external forms assumed by flint. A good deal of misconception appears to have arisen on the subject through a too exclusive attention to one particular form of flint arbitrarily selected as *a type of all others*. For this (generally the irregular nodular form) a theory is framed which is then made to account for the rest. Thus, when Dr. Bowerbank attempted to show that flints are silicified horny sponges, he accounted for the flint-veins of the chalk by supposing them to be horny sponges which had grown over the sides of an open fissure at the cretaceous sea-bottom; and Dr. Wallich, after giving an explanation of flint nodules and layers, speaks of the veins as formed by a 'sluggish overflow' of silica-saturated protoplasm 'into fissures in the chalk.' There does not appear much to choose between these rival explanations of the veins; both are attempts to *square* a preconceived hypothesis *with an obnoxious fact*" (*loc. cit.* p. 450).

Mr. Sollas is doubtless aware that Dr. Bowerbank can no longer answer for himself. He has, however, associated my name with that of a universally respected and known scientific thinker and writer, whose researches on the Sponges alone ought to have protected him from an imputation which, applied as it has been to myself as well as to Dr. Bowerbank, I can only describe as being wholly unfounded.

Mr. Sollas has taken care not to state at what page the words he here quotes from my paper are to be found. I will supply the omission. The seven words in question constitute the sole allusion to the flint-veins made by me, from beginning to end of my paper. The context, now furnished, will show that the *formation* of the veins was *not* what I was speaking about, but the "*homogeneousness*" *of the colloid material* contained in the fissures. In my paper I offered no other opinion whatever on the veins, for reasons which I considered sufficient—the allusions to sluggish overflows into the fissures of the chalk being made solely with a view to point out that, had they been filled with an *aqueous solution*, the fissures would not only have been lined with silica, but the walls of the fissure would, to a considerable depth, have become silicified through the absorbent power of the chalk. This view I still regard as valid, and as applicable to the tabular layers of chalk also. The following is the sentence from which Mr. Sollas has detached and quoted (as I shall show he has done in other instances) an incomplete passage, in order that he might impugn it:—"But that the colloidal *idiosyncrasy* of silica performed a much more important function in the phenomena connected with the flints than has heretofore been supposed, appears to me to be indicated by the evidence of the almost perfect incorporation of the organic silica with a colloid material, the unique amœbiform nodulation of the flints, and *its homogeneousness*, whether occurring in nodules, in *continuous sheets* parallel to the stratification, *or as sluggish overflows into fissures in the chalk*" (*loc. cit.* p. 89).

Again, at p. 451 of his paper Mr. Sollas says:—"In attempting to find an explanation for the form of these flints we may consider the following suppositions:—(i) The *form* may have been determined by the presence of animal matter (protoplasm, *Wallich*), or (ii) of the products of its decomposition," &c. . . . "The first explanation *may best be stated in Dr. Wallich's own words*. Thus, speaking of the irregular nodules, he says:—'those characteristic *amœbiform* outlines which, according to my hypothesis, are dependent on the presence of, and the combination of the silica with, the accumulation of nearly pure protoplasm still sufficiently recent to have resisted admixture with calcareous or other matter' (*loc. cit.* p. 79). As I have already shown in the earlier part of this paper that flints originate as silicified chalk, *we need not spend time on a formal confutation of Dr. Wallich's hypothesis*; but when Dr. Wallich remarks that 'the various conditions that present themselves from the earliest elimination of the silica from the sea-water to the period when it becomes finally consolidated, have never, that I am aware, been consecutively followed out' (*loc. cit.* p. 89), I would take the liberty to refer him to a paper of my own, printed in abstract in the Quart. Journ. Geol. Soc. vol. xxix. p. 76 (1873), *where the steps are perhaps as consecutively followed out* as in Dr. Wallich's paper itself. *As my paper has never been published in full*, I shall make no apology for giving here a rather lengthy extract from it" (Mr. Sollas's paper, 'Annals,' Dec. 1880, p. 452).

Both the above extracts from my paper are so incorrectly given, and mutilated by the omission of the context, as to materially alter their purport, at the very time that Mr. Sollas informs his readers that "THE FIRST EXPLANATION *may best be given in Dr. Wallich's own words*," and prefaces his first quotation by saying that I was "*speaking of the irregular nodules*," in order to make it appear that I was then describing some part of my *hypothesis*. I was neither describing any part of my hypothesis, offering an explanation of any supposition, nor directly or indirectly making any allusion to the question of the nodules. I had been impugning a statement by Sir Charles Lyell, made under a misapprehension of certain facts which I was relating concerning the very insignificant part played by the Diatomaceæ in supplying the silica of the flints, and was repeating generally what I had been at great pains in proving, for the first time, by detailed evidence, that "the comparatively bulky siliceous framework and spicule-system of the deep-sea vitreous sponges must constitute the main source of supply of the material for the flints." Speaking of *this*, I continued as follows:—"Indeed, it is far from improbable that the true flints are produced solely in the areas occupied by the sponge-beds, the flints becoming (elsewhere) more cherty and DEVOID *of those characteristic amœbiform outlines* which, according to my hypothesis, are dependent" &c. (see my paper, p. 79). Therefore, to cite this passage as an "*explanation*" of my hypothesis, more particularly as it was not described by Mr. Sollas either before or afterwards, was a mere abuse of words, if not of facts!

In the second of the above extracts Mr. Sollas pursues the same course of destroying the purport of the passage by suppressing the context. Such a method of supplying the *ipsissima verba* of a writer might, in skilful hands, be so applied as to warrant the impression that the best hypothesis that ever was constructed was not worth the ink it was written with. In the present case, so finely had Mr. Sollas drawn the line as to deprive the sentence he quotes of a definitely expressed limitation, by omitting the word "But," with which it commences.

The following is the paragraph from which the extract is taken:—"That the predisposition of silica, itself in reality a colloid, to form colloidal combinations with albuminous and other materials was known long before deep-sea exploration was dreamt of, is a well-known historical fact; it has been alluded to by most of the writers who have attempted an explanation of the mode of formation of the flints. *But* the various conditions that present themselves, from the earliest elimination of the silica from the sea-water to the period when it becomes finally consolidated, have never, that I am aware, been consecutively followed out" (see my paper, p. 89).

It will be seen from this that I had distinctly shown, in the previous part of the paragraph from which the quotation is made, that I laid no claim to originality in reference to the abstract chemical questions concerned on the subject of colloids and notably of silica. Yet, incredible as it may appear, the four next pages of Mr. Sollas's paper, which are taken up with the said "lengthy extract," contain not a single observation that is not wholly connected with the chemical and molecular changes that take place in the formation of flint nodules, and the infiltration with silica of certain shells from the Blackdown Greensand beds, which has no direct bearing whatever on the questions now before us. Indeed the concluding paragraph of the extract proves this; for in it the writer says:—"Thus the crystalline state of flint nodules offers us no evidence for or against our theory of the formation of these fossils. This theory may be summed up under two heads:—(1) combination of silicic acid with animal matter of various kinds—*a chemical fact*; and (2) *concentration of the silica from the silicate of animal matter thus formed, by the extrication of the organic part of the compound. This is a pure assumption*, but one which agrees very well with other well-known facts in chemistry" (*loc. cit.* p. 456).

Again, speaking of the irregular forms of the flint nodules, Mr. Sollas observes, at p. 459 of his paper:—"These, by their fantastic flowing outlines, are responsible for much of the theorizing which can only regard flint as a silicification of organic matter. Thus, Dr. Wallich repeatedly lays stress on 'the unique amœbiform nodulation of the flints,' though one may remark that one of the characteristic features of an amœbiform outline is that it seldom remains the same two minutes together; and this cannot be said of flints, although, as Dr. Wallich speaks in another place of the flints showing 'signs of the specific contractility of colloid silica,' one might infer that he does not regard this character as absent. A flint moving by means of its pseudopodia would be an interesting object; but perhaps the distinguished writer merely alludes to the excessive shrinkage which colloid silica undergoes in passing from the pectous to the solid state; and certainly, to one who has experimented with colloid silica, the wonder on Dr. Wallich's hypothesis would be, not that the flints show signs of shrinkage, but that they do not present them more markedly. The time for conclusions based on superficial resemblances is now gone by; we no longer regard 'dendrites' as fossils on account of their moss-like form, nor profess to be 'able to tell an honest man by the smell'" (Mr. Sollas's paper, p. 459).

This extraordinary composition may, or may not, have been written in a wholly serious spirit. It has appeared, however, in a journal occupying a foremost rank in the scientific literature of our time, and is therefore calculated to engender an idea that it embodies a legitimate criticism upon views correctly ascribed to me. This is, in itself, a more than sufficient reason why it should be seriously answered, and why some other personal observations made by Mr. Sollas in the same journal, in regard to my writings, should receive distinct refutation at my hands.

Since Mr. Sollas has become so zealous an advocate for preciseness of expression on the part of a non-professional naturalist as to take exception at the use of the word *amœbiform*—which he alleges, but incorrectly, was "repeatedly" employed in my paper,—how comes it, I would ask, that, in the very same paragraph that contains his criticism, he should himself have described, in language of his own selection, and, it is to be assumed, conforming in all respects with his enlightened views, "the irregular and fantastic FLOWING outlines of the flint-nodules" as being "responsible for much of the theorizing" he refers to; my name being pointedly associated with this observation? And how comes it that, in the 'Annals' for December last (p. 38), he should, when speaking of the FORM of these nodules, have thus expressed himself:—"In form they vary greatly, some being flabellate, some irregularly conical, others consist of a somewhat ellipsoidal body on a short stalk, while many are irregular and AMORPHOUS"?

The word amœbiform, though a hybrid and but little removed from the Latin and Greek jargon which day by day threatens to drive plain English out of our scientific terminology, is undoubtedly expressive of the unique kind of *outline* and *nodulation* I desired to picture. There is no English equivalent for *Amœba*, and consequently none for *amœbiform*. Hence no other word could have adequately conveyed my meaning. It was accordingly used by me; and I stand by it.

Before passing on from this portion of my subject, I beg leave to say that the tone of Mr. Sollas's remarks, and more particularly of the last-quoted paragraph of his paper, would have been answered only by one general expression of reprobation on my part, but for the way in which he has attempted to make the personalities and other matters I complain of serve the purpose of depreciating my opinions, and has thus left me no alternative but to enter fully into the facts.

Mr. Sollas opened his paper by citing the opinion of Ehrenberg and Sir Charles Lyell (which he says "is supported by Dr. Wallich" and others) that the silica of the flints "has been derived from siliceous organisms, either collected into distinct layers or scattered through some other deposit, like the siliceous remains now found dispersed in the Atlantic ooze." A glance at p. 265 of Sir Charles Lyell's latest work, 'The Student's Elements of Geology,' will nevertheless show that such was not the opinion entertained in 1871 by that illustrious geologist. I can answer for myself, moreover, that no opinion of the kind has ever been entertained or expressed by myself, either elsewhere or in my paper on the Chalk flints. Referring to the analogy that has been drawn between the Atlantic mud and the chalk, and the inference which he alleges has been based on this analogy, "that siliceous organisms were at one time present in the chalk, just as they now are in the ooze," Mr. Sollas states that he will at once "proceed to make this inference independent of analogy, by showing that it is really nothing less than a statement of fact" (*loc. cit.* p. 438). And this he immediately claims to have done on evidence afforded by the Trimmingham flints, which goes "*straight to the point*," but which I venture to affirm leaves the inference as thoroughly dependent on analogy as ever it was—the only change in the situation being that, whereas I and other writers on the subject avowedly drew our analogy from analyses of chalk taken from the middle of a chalk-stratum, he drew his, not, as he pledged himself to do, from the Trimmingham *Flints*, but from chalk adherent to the crevices of the flint-nodules, and separated from them by washing and subsequent treatment with hydrochloric acid. It is true he does not confine himself in this matter only to the evidence afforded by the Trimmingham flints, but says his conclusions are supported by what he has observed at the Niagara chert-beds, the Carboniferous beds of Scotland and North Wales, and also in other English strata. But at p. 441 he says, in reference to "a difficulty" he has encountered:—"This is to be found in the restriction of the flints to definite layers in the chalk, the chalk above and below being free both from them and from sponge-spicules. It is difficult to see, in the first place, how a shallow sea came to consist of a strong solution of silica, and still more so to understand how it came to vary in a rhythmical fashion, sometimes being concentrated enough to lead to the formation of flints, and again pure enough to leave the intervening chalk almost absolutely devoid of silica." His "statement of fact," as derived from the occurrence of great numbers of sponge-spicules adherent to the nodules, goes for nothing therefore, in so far as the present question is concerned.

But Mr. Sollas claims to have obtained proof of another kind, in the presence in limestone-rocks of minute quartz-crystals and chalcedonized shells, and occasionally "numerous grains of silica with a radiate crystalline structure"—and notably in the mountain-limestone of Caldon Low, in which were found a large number of crystals, which he rapturously describes as being "six-sided prisms terminated by six-sided pyramids, the usual form of rock-crystal," and immortalizes by adding that it may "be accepted as a fact that in the mountain-limestone these beautiful crystals abound." A great many more details are furnished, relating to the microscopic measurements of these crystals, their being "beautiful polariscopic objects," &c., all of which information is no doubt excellent in its way, as showing that indubitable, minute, and perfectly-formed rock-crystals have "somehow" been produced from silica in aqueous solution; but in this, as in the previous case, not a single new or additional fact is brought forward which can in any wise connect the silica of the crystals with the silica of sponge-spicules, or furnish a pretext for assuming that they may not, with just as much probability, have been formed from the silica always held in solution in sea-water, and which is said to be derived principally from the comminuted siliceous débris of felspathic rocks brought down to the sea by rivers*. Therefore, until this connecting-link between the Trimmingham flints and the spicules found on the chalk adherent to them (but only mechanically) can be positively affirmed, and between "calcitized siliceous sponges and the deposited silica," which, we are told, "is generally to be found somewhere not far off," Mr. Sollas must not be surprised at my regarding these mere "inferences" of his—probable, no doubt, but still mere inferences—with even less reverence than he regards the inference he could not deny was based, at all events, on a due amount of analogical reasoning.

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* See 'Student's Elements of Geology,' by Sir Charles Lyell, 1871, p. 265.

But this raises the very important question, whether the Trimmingham chalk and flints can, for the purposes of the present inquiry, with any propriety be ranked in the same category as the typical chalk-strata, which have as certainly been deposited at abyssal depths in the ocean as the Trimmingham strata have been deposited in comparatively shallow water. On this point I do not propose to offer an independent opinion, but shall content myself with citing the opinions of experienced geologists, and amongst others of Mr. Sollas himself.

Referring, in the first section of his paper, published in the 'Annals' for November 1879 (which was *really* a treatise upon the Trimmingham flint-spicules and nodules), to the Sponges which furnished the still-existing spicules, he says these "lived on a sea-floor probably somewhere between 100 and 400 fathoms deep." In the later (*i. e.* December) portion of his paper bearing the same title, after noting the fact that "currents have had some influence" in causing an addition to the proper spicular complement "of the Trimmingham forms from Sponges of other kinds," he again admits "the flints" in this locality "were not formed at any abyssal depth," but at from "100 to 400 fathoms, giving a pressure of from 20 to 80 atmospheres," by which he considers the solution of the spicules in sea-water might have been aided*.

Now, according to the authorities on the subject about to be cited, it will be seen that the average depth at which the ancient Cretaceous mud was deposited is so vastly in excess even of the *maximum* depth indicated for the Trimmingham deposit, that the conditions under which animal life existed in the two regions do not admit of comparison. In the one region the water immediately overlying the sea-bed must have been in a state of practically perfect quiescence; in the other (as collateral evidence, to be presently produced, will show), the water immediately overlying the sea-bed must have been in a state of constant and perhaps even powerful movement, owing to tidal and other currents. In the one region, sponge-life (the now admitted chief source of the silica from which the chalk-flints were formed) was in all probability developed, as it is known to be in our own day, to an enormous extent; and with it, of course, the dense protoplasmic environment which forms an organic constituent of the deep-sea sponges, and is, as I stated in my former paper, as indispensable a factor in the production of the flints, as they now present themselves in the Upper Chalk, as the silica itself which is derived from the sponge-spicules. In the other region sponge-life did, no doubt, occur to a certain and, possibly, considerable extent. But the condition of aqueous movement at the sea-bed during the deposition of the Trimmingham beds must there have constituted an insuperable obstacle (as it undoubtedly is to this day, at depths no greater than those determined for the Trimmingham beds) to the development of both the sponges and their protoplasmic nidus in sufficient abundance to lead to the formation of the typical black flint, which, according to my hypothesis, is as distinct in its mode of formation from the cherty varieties as the chert is distinct in its mode of formation from the chalk. Accordingly, the element of depth becomes a material factor in our present investigation.

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* *Loc. cit.* pp. 442, 444.

Professor Prestwich, when referring to "Submarine Temperatures" *, in his Address delivered in 1871 at the Anniversary Meeting of the Geological Society, observed :—" From these considerations the question arises whether the deep sea in which the Chalk was deposited may not also have been a sea shut out from direct communication with the Arctic seas " (*loc. cit.* p. 39). . . . " I think, therefore, that the hypothesis with regard to the continuity of that sea-bed (the Post-cretaceous Atlantic) from the period of the chalk to the present is one of high probability " (*ibid.* p. 41). And again :—" The Chalk, attaining as it does a thickness of 1000 to 1500 feet, was always looked upon by geologists as *the deposit of a very deep sea* " (*ibid.* p. 46). Mr. Whitaker, in his excellent 'Guide to the Geology of London' (The Geological Survey of England and Wales : 1875), says :—" By its fossils the Chalk is proved to be the deposit of a deep sea—a deposit of much the same character as that now forming in the mid-Atlantic, and which, like the Chalk, is largely made up of the remains of microscopic Foraminifera " (*op. cit.* p. 19). And, lastly (though many additional authorities to the same effect might be cited), Professor Martin Duncan, during the discussion which followed the reading at the Geological Society of Mr. Sollas's own paper " On the Markings in the Chalk of the Yorkshire Wolds," observed that "no reef-building corals are occupants of the deep sea, on which there is little doubt the Chalk was deposited" (Quart. Journ. Geol. Soc. 1875, p. 419)—an authoritative statement which it is somewhat unfortunate Mr. Sollas should have overlooked, inasmuch as it might possibly have saved him from drawing a very misleading parallel between the flints of the Trimmingham and those of really typical Upper-Chalk strata.

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* See the elaborate and admirable memoir entitled " Tables of the Temperatures of the Sea at different depths, reduced and collated from the various observations made between 1749 and 1868, with maps and sections. By Joseph Prestwich, M.A., F.R.S., &c.," Phil. Trans. Roy. Soc. vol. 165, pt. 2, 1874.

On the other hand, we have it on the authority of an observer, whose opportunities of arriving at a correct estimate of the mean depths at which the modern deep-sea calcareous deposits are being formed have never been equalled, that *there can be no doubt whatever* that we have, forming at the bottom of the present ocean, a vast sheet of rock, which very closely resembles chalk;" and "*there can be little doubt that the old chalk was produced in the same manner and under closely similar circumstances*" ('The Depths of the Sea,' 1872, p. 470).

But another, and perhaps the most material, fact in relation to the Trimmingham beds remains to be noticed. It is one on which I lay very great emphasis, as proving that a large proportion of the spicules (on which Mr. Sollas has based the whole of his superstructure of argument in relation to his hypothesis of the flint-formation as a whole) have, in all probability, been both drifted to and fro on the sea-bed and subject to very powerful disturbing agencies, and accessions from other more or less littoral localities, since the period when the associated Cretaceous deposit was formed. The fact referred to is described in a letter from Mr. Clement Reid, of H.M. Geological Survey of England and Wales, which was published in the 'Geological Magazine,' Dec. 2, vol. vii. p. 238. Mr. Reid, after remarking on another explanation that had been suggested, says:—"My difficulties in accepting the view that the contortions were formed by the dead weight of masses let down from above are, firstly, that I cannot find a single case where uncontorted beds have been deposited over the contorted one, though at first sight many sections have that appearance; and, secondly, that no weight we can imagine possible could drive up the solid chalk at Trimmingham in a ridge three quarters of a mile long from N.W. to S.E., and apparently about 250 yards wide, *this disturbance, it must be remembered, affecting not only the chalk, but* 200 *feet of overlying clays and sands*." Any commentary on such evidence is, I submit, unnecessary; for, to quote a favourite expression of Mr. Sollas's, "these facts speak for themselves."

But, strange to relate, Mr. Sollas arrives at the conclusion that "the once existing spicules are absent from the Trimmingham deposit—not because they have been washed away, but *dissolved*; for they are invariably absent in fossil sponges and stratified deposits. Neither Zittel nor I" (he says) "have seen a trace of them; and my observations on the comparative readiness with which they undergo solution in—CAUSTIC POTASH, *serve to explain their absence*"! (*loc. cit.* p. 442).

If *these* are not "inferences," they are something more, namely pure assumptions—the first an improbable assumption, the second worse than improbable, since every schoolboy knows nowadays what the action of "caustic potash" is on silica, and that caustic potash is certainly not one of the ingredients which chemical analysts have heretofore detected in *oceanic* waters. It is therefore "a self-evident truth" that the solution of the Trimmingham sponge-spicules on the sea-bed could not, under any known conditions, have been due to the substance referred to, even were it possible for the alkali to exist in sea-water in the form of hydrate. Besides there is no other substance in sea-water which possesses even an approximate solvent energy upon silica. "The chemical fact" referred to (*loc. cit.* p. 456) cannot, therefore, under the most strained interpretation, be regarded as "serving to explain," or being connected with, "the absence of the spicules" from the Trimmingham deposit. Nor, coupling it with what has been previously advanced, can it be regarded otherwise than as demolishing Mr. Sollas's claim to having made a demonstrated fact occupy the place either of analogy or inference. And, going yet a step further, if we take the whole of the facts that have up to this point been recorded, I venture to think it has been indisputably proved that no parallel can be drawn, for the purposes of the present inquiry, between the Trimmingham Chalk with its flints and the White or Upper Chalk with its flints, or even the typical calcareous deposits of the modern Atlantic sea-bed. Should this conclusion be correct, it follows, as a natural consequence, that the whole of the arguments and hypotheses Mr. Sollas has, with so much confidence, based solely on evidence supplied by a shallow-water cretaceous deposit like that of Trimmingham, subject as it must have been to disturbing tidal and current-influences during the period of its deposition, and to still more violent and cataclysmal agencies afterwards, must be looked upon as untenable.

I will now proceed to consider two other important questions which have a direct bearing on the flint-formation. The first is:—Does the ordinary theory of replacement of carbonate of lime by silica, which has been so ably discussed by

Prof. Rupert Jones and others, account for all the phenomena? The second:—Is flint, the true black or typical flint of the Upper or White Chalk, a crystalline, or an amorphous and, to a certain extent, colloid body?

It has already been stated that, according to Mr. Sollas, "*flints originate as silicified chalk*" (*loc. cit.* p. 452). "It would appear (he says) that the simple deposition of silex is impossible in the Chalk; the first STAGE of deposition in this deposit is *always* that of replacement (*ibid.* p. 451)." And again:—"Briefly to sum up, a deposit of sponge-spicules accumulated in the chalk *ooze*[*], and in the presence of sea-water under pressure entered into solution. Replacement of the calcareous material of the ooze then ensued, small shells, and many large ones too, being converted into silex; and *siliceous chalk, not flint*, was the result. The chambers of the Foraminifera and the interstices of the chalk were *now* filled up by *a simple deposition of silica*, and the siliceous chalk became converted into *black flint*, an incompletely silicified layer of chalk remaining as the white layer of the surface" (*ibid.* p. 449).

It will, I think, be admitted that it is no easy matter to divine, from this extraordinary description, what the distinction is which the author desires to convey between *his* version of the replacement-theory, that "flint originates as silicified chalk," and the generally accepted view, that "the flints are due to the replacement of carbonate of lime by silica"—apart from the fact that the former is an unnecessarily complicated mode of expressing the latter, which, as it stands, is both plain and to the point. But it will be observed that Mr. Sollas divides the process into two distinct parts, which he dignifies by the name of "*stages*," without in any wise intimating what is to be gained by this division. The first stage (he tells us) commenced with the solution of the sponge-spicules in sea-water under pressure, and ended when the calcareous ooze, with some small shells and many large ones too, became converted into silex, through the replacement of carbonate of lime by silica—*siliceous chalk*, but *not flint*, being the result; whilst the second stage commenced with the filling-up of the *chambers* of the Foraminifera and the *interstices of the chalk* by a simple deposition of silex, and ended when the siliceous chalk became converted into black flint, an *incompletely silicified layer of chalk* remaining as the white layer of its surface.

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[*] This is an assumption, since no accumulation of spicules "*in the ooze*" at all sufficient to account for the flint-formation has as yet been recorded by any deep-sea observer. I have seen nothing in the North Atlantic that could meet the requirements of the case. I was the first, however, to point out and furnish valid reasons for concluding that the substance called "*Bathybius*," which from the first I suspected to be no independent living organism, is merely the *effete* residuum of deep-sea organic life and the protoplasmic *nidus* of the deep-sea vitreous sponges, whose existence, in inconceivably vast numbers, over the calcareous areas of the sea-bed, had been conclusively demonstrated during the cruises of the 'Porcupine' and 'Challenger.' (See my paper "On the Cretaceous Flints," pp. 74–77.)

The replacement-theory as taught by Prof. Rupert Jones* is undoubtedly applicable to the flints, so far as it goes. Mr. Sollas's version robs it of this attribute. For how and why the replacement by silica, admitted to have extended, during the first stage, to the *ooze* and some small and many large shells, should not, without let or hindrance, have, at the same time, entered the chambers of the Foraminifera, which, though small, present no peculiarity of structure that could interfere with the penetration into their chambers of the "simple" siliceous solution—how or why this solution should have reached the calcareous particles of the ooze and certain shells without gaining access to them through the *interstices* existing amongst the oozy particles themselves, and should not in the first instead of the second stage have silicified these interstices—and, above all, how or why the siliceous solution, which, from the commencement of the first to the final completion of the second stage, must necessarily have gained access to the interior of the mass of ooze by permeating its boundary-walls, should have failed throughout to silicify these, and should have left them in the shape of an "incompletely silicified layer of *chalk* remaining as the white layer of its surface," are problems far too subtle for ordinary understandings to grapple with, although Mr. Sollas appears to have long ago solved them to his own satisfaction, as the following remark, at p. 452 of his paper, somewhat personally attests:—

"As I have already shown, in an earlier part of this paper, that flints originate as silicified chalk, *we need not spend time on a formal confutation of Dr. Wallich's hypothesis*"!

These details may appear wearisome, and, could they be taken apart from Mr. Sollas's conclusions, might with advantage be ignored. They become important, however, when viewed in connexion with the fact that they rendered it necessary for me to show on what grounds I reject those conclusions; and I mean from henceforth in this paper to discuss only the replacement theory of Prof. Rupert Jones, although compelled to dissent from it to the extent of maintaining *that it performs no part whatever* in the production of the true or black flint of the Upper Chalk, which, apart from its *imbedded pseudomorphs* of Foraminifera and other organisms, and their comminuted *débris*, I regard as having, from first to last, passed through the following stages:—first, in the state of inorganic, and probably some organic, silica held in solution in sea-water under the special conditions prevailing at the deep-sea bed; then, in the shape of sponge-skeletons and spicules*; next, of silica in its gelatinous and perfectly colloidal condition; and, finally, in the form of the flints.

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* Prof. Ruper Jones qualifies the theory by adding:—"As this mineral (silica) rarely succeeds calcite as a true pseudomorph, it is only the amorphous, or detrital, carbonate of lime of the organisms constituting the limestone that has been replaced by silica (as flint &c.), and not the crystallized material of Echinodermatal spines &c. . . . . . the guards of *Belemnites*, nor the shells of *Inoceramus, Ostrea, Terebratula*, &c." (*loc. cit. antè*, p. 447).

In short, every imbedded pseudomorph, without exception, consists not of pure but of impure flint; in other words, it becomes cherty, and ought to be in the strictest sense regarded as an "*inclusion*." Moreover the whole of these pseudomorphs included in, but not forming part and parcel of, the pure flint (of course omitting the large foreign bodies, such as Echinoderm and other shells, which so frequently form a nucleus, around or within which the colloidal silica has collected), if consolidated into compact masses, would rarely, if ever, occupy a space that would not be insignificant in comparison with the bulk of the remaining mass of pure flint in which they had been imprisoned. In their case replacement of carbonate of lime by silica must undoubtedly have taken place, precisely as it takes place when large masses of shell, as, for example of *Inoceramus*, have been accidentally entrapped in the still plastic and viscid colloid. But inasmuch as it would be a palpable error to regard such foreign bodies as integral portions of the flinty matrix, even though occurring in the highest stage of silicification, so long as there is the slightest trace of the opalescence resulting from the combination of the silicic acid with a mere remnant of the calcareous or fibrous tissues, so it would be a palpable error to regard the minute organisms which are almost invariably imprisoned in the flint, like insects in amber, as constituting integral portions of the imprisoning material. Or, *per contra*, if these are regarded as integral portions of the flint structure, so must the cherty rind or crust of the nodular flints, and the white outer coating of the tabular layers, both of which are due merely to the accidental entanglement in the still viscid colloidal mass of silica of minute calcareous organisms and their *debris*, "*the imperfectly silicified layer of chalk* remaining as the white layer of its surface," as it is very properly described by Sollas, be also thus regarded—a conclusion that would obviously be absurd.

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* For the purposes of the present inquiry, I have deemed it inexpedient to include the Polycystina, and other minute siliceous-shelled structures, the silica of which, though undoubtedly contributing their quota to the general volume of the flints, exists in such a comparatively small proportion as not to deserve mention in discussing the general question of the flint-formation.

Were the replacement theory applicable except in the case of the cherty varieties, there would be no such thing as pure flint; but we should have in lieu of it a composite mass, not homogeneous and, at times, almost translucent, but a substance identical in every respect with the cherty core that occasionally occupies what was, in the nascent state of the nodule, a portion of calcareous mud around which the colloidal mass of silica and protoplasm combined had closed in so as to form an internal chamber or cavity, the outer surface of the never *absolutely* silicified contents passing transitionally, though sometimes somewhat rapidly, from perfectly pronounced chert to perfectly pronounced flint.

It is true that Mr. Sollas seems to have such unlimited faith in the silicifying powers of his hypothesis that he sees no difficulty in supposing that "concentration of the silica" from the "silicate of animal matter," formed by the combination of silicic acid with animal matter of various kinds, may take place *by the extrication of the organic part of the compound*;" though he admits that this supposition is a "pure assumption which agrees very well with other well known facts in chemistry" (*loc. cit.* p. 456). At page 454 he says, "In all these and similar cases the silica, concentrated by the *dissipation* of the animal matter, which seemed in the first place to imprison it from solution, might remain in the crystalloid or the colloid state; at this distance of time we cannot determine." But even this extreme and ambiguously expressed view of the potentialities of colloid matter would hardly be tenable in these days, as explaining the only practicable way in which the annihilation—for it must be that or nothing—of the basal organic substance could be brought about which enters into the constitution of every shell and spicule, and which contains one elementary body that is certainly not an ingredient of pure flint, and could be got rid of *only* by entering into chemical union with another of the released elements to form carbonic acid. How comes it, then, that the constituent elements of the basal organic matter of the Foraminiferal and other calcareous, and, indeed, of all siliceous-shelled organisms, including the sponges themselves (whether we bury our heads and call it *spiculin*[*], or *glairine*[†], or acanthine[‡], or even *Bathybine*[§]), if all absolutely "*dissipated*," or "*extricated*," should leave *any* pseudomorphic forms behind at all? If pseudomorphs, the pseudomorph must represent *something* that has been replaced. But under the extraordinary conditions assumed by Mr. Sollas they can represent *nothing*—a logical situation from which I shall certainly not attempt to dislodge them, for most obvious reasons.

I may here mention another of the reasons which induce me to reject the replacement theory as applicable to the true flint. It is the fact that, were no powerful restraining influence at work on the sea-bed wherever the calcareous deposits occur, such as arises out of the nearly absolute insolubility in sea-water of sponge and Foraminiferal protoplasm, and of the now gelatinous and colloid silica in combination with it, instead of well-defined strata of chalk alternating with nodular and tabular layers of flint, the stratum of the one substance never encroaching upon or becoming deeply fused into the stratum of the other so as to render it doubtful where chalk entirely ends and silica begins (evidence being in this wise furnished of their insulation from each other being dependent on some chemical or molecular agency present in the one which is absent in the other), the replacement process would have had no definite limits, and must have been exerted indeterminately. This would have resulted in the production, in lieu of stratified chalk with intercalated and conformable layers of flint, of siliceous limestone, either with or without concretionary masses of chert distributed through it, probably without any regard to regularity. And, lastly, we should certainly not meet with nodular flints bearing unmistakable evidence of a highly colloidal origin. Nay, it is perhaps not going too far to say that, in such a case, the entire mass of organic rock known as chalk would, through the replacement of the whole of its carbonate of lime by silica, which had penetrated in a state of very dilute aqueous solution into every nook and cranny, have become converted into one stupendous pseudomorphic mass of compact silicified limestone.

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[*] Prof. Sollas's paper, p. 445.

[†] Alexis Julien, in ditto, p. 457.

[‡] 'The Atlantic,' by Sir Wyville Thomson, vol. i. p. 340.

[§] G. C. Wallich, *suprà*. I would repeat here what I stated in a footnote at p. 73 of my paper on the Flints, that I used the word "*protoplasm*" only because it is less specialized than either *sarcode* or *albumen*. It will be time enough to give it a distinctive name, as applied to enveloping albuminoid substance of the sponges or the basal organic substance of their siliceous parts, when we really know in what the distinction between the various guises under which protoplasm appears shall be more precisely determined than it has hitherto been.

It must not be imagined, however, that the views now so confidently advocated are based on mere assumption unsupported by a fair amount of relevant evidence—as relevant perhaps as any evidence can be that relates to natural operations that may in times past have been, or may even now be, carried on at abyssal depths in the ocean*. I have from time to time, during a long-continued study of the flint question, seen specimens of limestone thickly studded with fossil diatoms, not one of which, even when examined under a microscopic power amply sufficient to exhibit any loss of substance or form, exhibited the least trace of having undergone solution; the calcareous matrix of the limestone, crystalline and apparently deposited from solution, enclosed the diatom-valves, which remained as distinct from each other, although in the closest mechanical contact, as it was possible for them to be. It is, doubtless, both possible and probable that some of the more delicate of these structures may have undergone complete solution; for, as pointed out by me nearly twenty years ago, the *Acanthometræ*, a remarkable and very beautiful group of siliceous organisms inhabiting only the surface-waters of the open ocean, often in immense numbers, are never found in recent or fossil oceanic deposits. This I showed to be the result of the unusually large admixture of basal protoplasm with silica, of which their spines are composed, and which imparts to them a very distinct optical character, causing them, in virtue of this excess of colloidal matter, invariably to dissolve away in sea-water before their remains can sink down to the bottom. Some diatoms likewise present this character; and accordingly these may, if they formerly existed, have vanished from the limestone under notice. But, as already stated, the whole of those still visible remain perfectly intact, and, when seen in delicately cut sections, retain their characters so perfectly as to enable their marine origin to be positively determined.

As bearing directly on this question, I will here quote from my 'North-Atlantic Sea-bed,' published in 1862, with a view to show that even at that early date I had given the subject some careful consideration, though all my conclusions may not have been strictly accurate:—"It is probable that the saline and mineral substances present in sea-water exercise a much more marked effect on the formation of the organic deposits of the deeper zones of the ocean than has been admitted under the 'antibiotic' view so often referred to. From the nature of the difficulties by which the inquiry is surrounded, not only is the chief portion of our knowledge regarding the deep-sea bed rather of a theoretical than a practical kind, but unfortunately it must long continue to be so. It is therefore doubly expedient to test this knowledge by the light of every fact that science or accident may throw in our way. . . . . If we examine the siliceous concretions, our perplexities increase rather than diminish; for whilst remains of siliceous-shelled organisms are to be met with in them, it is very remarkable that they do not belong to the family of siliceous-shelled Rhizopods that next to the Foraminifera are most largely represented at the bed of the ocean, namely the Polycystina; and *there is no authenticated example up to the* present period of a *Polycystine shell having been detected in a flint. From the nature of the hydrosilicates*, we could hardly expect to find the *forms* of siliceous organisms preserved; hence it is possible that the mineral atoms of the Polycystina have become merged as it were into the substance of the masses. But since we constantly detect siliceous spicules of sponges, which have not yielded to disintegration though similarly formed, it is difficult to reconcile the apparent anomaly. If we regard the concretions as principally made up of sponge-spicules, the case is but little altered; *for the pseudomorphs of the calcareous* shells of the Foraminifera are plentiful in their substance, and indicate that the conditions under which they were formed and silicified were such as might have been shared by the testaceous Rhizopods generally" (*op. cit.* pp. 120, 121). "Again, in those marine deposits in which the Diatomaceæ are sufficiently abundant and well marked to indicate that they had lived in the immediate locality, it may be taken for granted either that the water was shallow or that the deposit was formed along a coast-line, *since no Diatomaceæ* live at greater depths than from 400 to 500 fathoms. In the deep-sea beds where Diatomaceæ occur, the characters of the species, their variety, and their limited numbers, at once show they had been drifted from distant shallows, or were free floating surface forms which had subsided to the bottom after death. Whilst as yet we have no positive proof that the Polycystina live at extreme depths, it is a very significant circumstance that the large assemblages of these organisms hitherto met with in such a recent state as to indicate vitality occur in deep water, and that the forms taken alive at the immediate surface of the ocean in some latitudes are sufficiently distinct to prove that the same species do not occur at the surface and at the bottom without undergoing marked modification. On the other hand, there is reason to believe that some of the siliceous organisms met with in a living condition at the surface of the open ocean cannot live at any great depth, and that, *from some peculiarity in molecular constitution, the siliceous portion of their structure yields to the solvent power of the water. Thus the Acanthometrina*, a small group of organisms with siliceous frameworks of extreme symmetry and of such characteristic shape as to be readily distinguishable, occur in tolerable profusion in tropical and subtropical latitudes; *but, strange to say, not a trace of their siliceous remains is to be found either in recent or fossil oceanic deposits*" (*ibid.* pp. 126, 127).

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* It is almost needless to point out that, in all questions relating to the conditions and changes taking place at the bottom of the ocean, assumption and hypothesis must, for many a day to come, occupy the place of demonstrated facts. Hypotheses are the advanced guard of knowledge, and, if properly equipped and cautiously sent forth, minimize the risks of fallacy when exploring an unknown region in science.

I have still in my possession unmounted and mounted material obtained by me in 1857 from the surface of the Indian Ocean, and Southern and Mid-Atlantic Ocean, containing specimens, in considerable numbers, of *Acanthometræ*, *Polycystina*, *Dictyochidæ*, *Diatomaceæ*, and *Sphærozoidæ*—the mounted specimens in Canada balsam, the crude material in dilute alcohol. In both cases, the *Acanthometræ*, and some of the very delicate oceanic *Diatomaceæ*, with the thin-shelled *Sphærozoidæ*, were the first to show signs of solution, about ten years after they were obtained. In twenty years most of these had vanished as visible structures, but the *fluffy* residuum of their *sarcodic* bodies remained. Now some of the more solidly built forms are beginning to yield, and probably will do so in the course of a few scores of years, which, it is almost needless to say, is but a moment in comparison with the periods involved in any of the great chemical or molecular changes brought about in Nature. But, surely, no fact could be more clearly indicative of the potency residing in *protoplasm* than the one just furnished, these minute siliceous structures having, undoubtedly, given way under the powerful colloidal properties of what was once their own body-substance.

What, then, do these facts prove? First and foremost, they prove, by the presence of forms belonging to genera which invariably live along coast-lines*, and possessing stalk or cushion-like processes whereby they anchor themselves to rocks or shells, or algæ at the bottom of the sea, that the deposit in which their remains occur could not have been formed at any great distance from land, and that they were, in all probability, drifted by tidal or other currents into those areas in which they became finally accumulated. This, coupled with the almost entire absence of sponge-spicules, tends moreover to prove that there were no siliceous sponges in those areas, and, consequently, that the only substance which would have *ensured* their solution, namely sponge or Foraminiferal protoplasm (for in like manner no Foraminifera are observable in the limestone), *was entirely wanting.* Hence their immunity from destruction and perfect preservation in the limestone.

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* At depths probably never exceeding 50 or 60 fathoms.

Of the existence of pure Diatomacean deposits at much greater depths in the ocean and at vastly greater distances from land than those just named, there is, as every biologist knows, abundant evidence—for example, in the antarctic regions, where they were discovered by Sir Joseph Hooker in 1843, and thirty years later by the naturalists on board the 'Challenger.' I have now before me sections of a Norwegian limestone literally crowded with marine diatoms of the kind already described, which are also in the same perfect state of preservation,—the inference I draw from these facts being that the unaltered condition of the organisms under notice is due to the very limited power of sea-water at moderate depths, and consequently under moderate pressure, even when aided by abundant products of animal and vegetable decomposition, to reduce silica *to a colloidal state;* and, conversely, that the superabundance, over the deep-sea calcareous areas, of siliceous sponges and their concomitant protoplasmic investment furnishes us with a highly probable and satisfactory explanation why flint-formation has taken place under one determinate set of conditions and has failed entirely to take place where these conditions are absent.

Reasons have already been given by me for regarding the simple deposition of silica from an aqueous solution, whether in the condition of flint which Mr. Sollas describes as "*crystalline*," or of pure rock-crystal, as furnishing no parallel whatever to the process of the true chalk-flint formation as it occurs in the chalk strata, in which I contend there is no *deposition* of silica in the ordinary acceptation of the term, but a still more simple process of solidification of two gelatinous colloids "*more or less rich*" (to quote an expression of Mr. Graham's) "*in combined water as at first produced,*" but which gradually part with their "combined water" to the surrounding medium, under the dialyzing action of their own gelatinous substance, and become more and more consolidated until the period arrives when they have lost the whole of their "hydration," and then "appear as a *colloidal glassy hyalite*" (in other words, as typical flint): see an invlauable paper by Mr. Graham, "On the Colloidal Properties of Silicic Acid and other Colloidal Substances," Proc. Roy. Soc. for June 2, 1864, p. 335, where nearly the whole of the changes and processes I have described, although not with relation to deep-sea siliceous deposits, will be found most lucidly set forth.

Mr. Sollas alludes throughout his paper, with one exception to be hereafter mentioned, to the flints as being composed of "*crystalline silica.*" This expression strikes me as being so remarkable that I must quote some of the passages in which it occurs. Thus, at p. 445, "The silica of the sponge-skeletons occurs in conjunction (or probably in combination) with an organic basis known as *spiculin*; on solution it is liberated from the spiculin, and exists in a colloid state, whence it readily passes into the pectous condition, and subsequently becomes hyaline; it is, moreover, probable that, *under conditions not yet investigated*, a solution of colloid silica may give rise *directly* to silica in a crystalline form." Again, at p. 455, alluding to the silicified Blackdown shells, he says:—"The crystalline silica, which the percolating water carries in solution, passes through the shell, and in some cases, under favourable conditions, crystallizes out in long fine prisms." At p. 456:—"Thus the crystalline state of the *flint nodules* offers us no evidence for or against the theory of the formation of these [the Blackdown] fossils." And "*from this process of reasoning* we conclude that colloidal silica has the power of changing, in course of time, into a static or crystalline condition." And, lastly, reverting to p. 445, from which the first of these extracts was taken, we find the "crystalline" view thus emphasized:—"If it be objected that in this expanded explanation fact and conjecture are mixed together, I to some extent admit it, but at the same time remark that there is no conjecture in the statement that the silica which passes into solution is very different from the silica which has passed out of solution. The one may be conveniently called organic, and *the other mineral silica*; the properties of the two are strikingly different; and the process which has really happened has been a solution of organic silica and a deposition of mineral silica, not a solution and deposition of the same kind of silica." The last truisms are quoted only because, as the entire passage stands, the term "*mineral silica*" would seem from the context to be a convertible term for "*crystalline silica.*"

On the other hand, I subscribe to the opinion which, if I mistake not, is very generally entertained by chemists, that the *flints* are neither perfectly pure, nor, under any circumstances, a truly crystalline form of silica—silica being of course the principal but not the sole constituent of the black flint met with in the chalk, which is a compound substance consisting of a purely flinty matrix, within which varying numbers of the disintegrated remains of minute calcareous and siliceous organisms may almost invariably be detected on careful examination. Thus, in Phillips's 'Elementary Introduction to Mineralogy,' the following, according to Klaproth, are the constituents of flint—"98 per cent. of silica, with minute proportions of oxide of iron, lime, alumina, and water."

It may also be here stated with advantage that, according to Graham, silicic acid or silica becomes more and more insoluble the purer or more free from combined water it becomes. Hence the gelatinous compound formed by the ready and intimate combination of organic silica with, and also within, a mass of protoplasm, *which is already an insoluble colloid*, is to all intents and purposes no longer *either soluble or miscible with water*; whilst on the question of crystallization Mr. Graham says, "I may *add that no solution, weak or strong, of silicic acid in water has shown any disposition to deposit crystals*, but ALWAYS appears, on drying, as a colloidal glassy hyalite. *The formation of quartz crystals at a low temperature, of so frequent occurrence in nature*, remains a *mystery*" (Graham, *loc. cit.* p. 335).

It is of the utmost importance to bear these last-named characteristics of silica constantly in mind, as upon them depends the preeminent tendency of this substance to enter into colloidal combination with any albuminoid substance, such as animal protoplasm. On the other hand, it is equally important to bear in mind that silica, the moment it has assumed its gelatinous state, although holding in combination a certain portion of water, *is practically insoluble in water.* Hence its inherent tendency, when combined directly with protoplasm, not to imbibe more water, but to part with all but the infinitesimally minute trace that remains in combination with it up to the period when it is exposed to atmospheric agencies on dry land—this expulsion of its combined water being the result partly of dialytic action, as already mentioned, and partly of its idiosyncratic tendency to contract (Graham, *loc. cit.* p. 336) more and more upon itself, and thus favour the expulsion of all but the last residuary quantity, before final and complete consolidation into flint*. This consolidation is also shown by Graham (*loc. cit.* p. 337) to be greatly assisted by the presence of alkaline salts and more particularly of *carbonate of lime.*

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* I have seen an interesting fact stated (but where, I am at this moment unable to remember), that flint-workers always find the flint softer and more easy to cut away in flakes immediately after it is extracted

According to Mr. Sollas's statement already referred to, silicic acid forms, with albumen and gelatin, *chemical* compounds, *silicate of albumen*, and *silicate of gelatin* (*antè*, p. 163, note), and Mr. Sollas reasons upon it as if it were an indisputable fact. It may be so; but, until I have some substantial proofs of the fact, I confess I shall continue disinclined to believe that any chemical compound, such as silicic acid, or protoplasm, can be broken up into its elements by simple mechanical means, such as solution or diffusion. Thus glycerine and water may be mixed in any quantities without losing their chemical identity. So may two gelatinous and colloidal substances, as in the case of silicic acid and protoplasm, as soon after the death of the parent organism as the purely material forces step into the field to cause a combination of the silica, which had, *in the first instance only*, yielded so far, but no further, to the *quasi*-chemical action by which silicic acid, in the presence of a powerful colloid, exchanged one unstable condition in which it can exist without chemical disruption, for another unstable condition in which it can also do so.

On these grounds I contend that the union of these two substances is a purely mechanical combination or intermixture, whereby they become amalgamated, as it were, *into an organic alloy*, capable of retaining just sufficient "combined water" not to interfere, in the least degree, with their mutual insolubility in the surrounding water. Organic silica, or, in other words, *silicic hydrate*, in the presence of protoplasm only, passes into its gelatinous phase as soon as the preservative action of the *living* organism ceases with its death. "Decomposition" at the sea-bed, in the presence of the various saline preservative substances contained in sea-water, the low temperature prevailing, and the stupendous pressure (which, in all probability, prevents any gaseous body from existing, save in its fluid condition), must necessarily be an extremely slow process. In the combined state of colloidal silica and protoplasm their insolubility helps still further to protect them from decomposition by excluding substances which might otherwise enter into chemical combination with them. They constitute an independent *regnum in regno*, the permanence of which is interfered with only by the inherent and powerful tendency of

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from the chalk rock. This would appear to be in some way related to its retaining its permanent minute residuary quantity of water only until its exposure to the action of the atmosphere.

the combined mass of colloidal silicic acid and protoplasm to contract upon itself, and thus to bring about, by slow and sure degrees, the separation of its combined water. But it is not until the transition is actually imminent, from the plastic condition of the still nascent flint nodule to the final consolidated state when the nodule may be regarded as complete, that the minute residuum of water, enabled under the enormous pressure to retain a portion of pure silica in solution, yields, for the first time since it formed a component portion of the siliceous mass, to purely chemical forces, and thus, by dialytic action, escapes in its elementary form from its long imprisonment. It is during the entire period, dating from the death of the parent organisms that furnish the silica and protoplasm, up to that at which the final consolidation takes place, that the innate tendency to the assumption, by the continually contracting mass, of the peculiar external forms which so signally characterize the flint nodules, exercises a determining effect upon them—this effect being in all probability at its *maximum* of energy in the early stages of the masses, and at its *minimum* in their latest stages, but never absent or materially interrupted in the quiescent solitudes of the ocean. It shall be shown hereafter *that dead and effete albuminoid matter, as well as living, evinces this tendency to assume* what I have termed, in the absence of a preferable word, *amœbiform outlines.*

The varying number and contiguity of the flint nodules in different strata of chalk, and in different parts of the same chalk-beds, prove that these variations are due to varying extent, bulk, and rapidity of growth of the sponge-fields and their enveloping nidus of protoplasm, both the siliceous and the albuminoid portions of these organisms being contributories to the flint-formation. Did the nodular flints really originate, as alleged by Mr. Sollas, in silicified chalk—if by this expression we are to understand that a siliceous solution derived from the solvent action of sea-water on the spicules, aided by a partial admixture with the products of decayed organisms, "replaced the calcareous material of the ooze,. . . that siliceous chalk (not flint) was the result, . . . and, subsequently, this siliceous chalk became converted into black flint, an incompletely silicified layer of chalk remaining as the white layer of its surface"—it is very difficult, if not impossible, to conceive why or how such flint assumed, under any ulterior conditions short of re-solution and combination with a plentiful supply of colloid matter, the amœbiform outlines I have so often alluded to. The replacement of carbonate of lime—whether in sponge-cavities, shells, the tests of Foraminifera, or masses of calcareous ooze—has never, that I am aware, been found coupled with change of form. On the contrary, we have in almost every pseudomorph, whether consisting of carbonate of lime after silica, or silica after carbonate of lime, or an admixture of both carbonate of lime and silica, a well-defined retention of the general outline of the object, although extending only to the ghostly remnant of the organic basal matter to which reference is made.

The necessary evidence is, I submit, therefore complete, of the black flint* not being the product, in any sense, of the replacement of one mineral substance by another, but the *direct* resultant of the gradual transition of its silica from a gelatinous to the "pectous" condition, during which the last removable vestige of its "hydration" is expelled and the production of "*the hard stony mass of vitreous substance*" called flint is consummated.

As these remarks apply more or less to the entire flint-formation, including the cherty varieties, I hereto append a few short passages from Mr. Graham's paper on silicic acid, to which I have already been so deeply indebted for guidance in the present inquiry, as I should of course wish to give the whole weight of that illustrious physicist's scientific authority to the statements that have been put forward on the subject. Having done so, I shall consider my case concluded, so far as the mode of production of the flints is concerned.

"A dominating quality of colloids," Mr. Graham wrote, "is the tendency of their particles to adhere, aggregate, and contract. This idio-attraction is obvious in the gradual thickening of the liquid, and, when it advances, leads to pectization. In the jelly itself the specific contraction in question, or *syncæresis*, still proceeds, causing separation of water, with the division into a coagulum and serum, and ending in the production of the hard stony mass of vitreous substance, which may be anhydrous, or nearly so, when the water is allowed to escape by evaporation. . . . Bearing in mind that the colloidal phasis of matter is the result of a peculiar attraction and aggregation of molecules, never entirely absent from matter, but greatly more developed in some substances than in others, it is not surprising that colloidal substances spread on all sides into the liquid and solid conditions. . . . It is unnecessary to return here to the ready pectization of liquid silicic acid by alkaline salts, including some of very sparing solubility (such as carbonate of lime), beyond stating that the presence of carbonate of lime in water was observed to be incompatible with the coexistence of soluble silicic acid, till the proportion of the latter was reduced to nearly 1 in 10,000" (*loc. cit. anteà*, pp. 336, 337).

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* Throughout my paper I have spoken of the *black flint* and the *typical flint of the upper or white chalk*, only because the characters I wish to account for are most strikingly seen in it.

Of course, between the most highly developed cherty form of flint and that in which is an admixture of foreign particles, of whatever kind these may be, there is an almost infinite gradation, depending, as I have in a former page pointed out, on the replacement, *now taking effect for the first time*, of carbonate of lime by silica. In order to understand by what very simple means this result is brought about, I will endeavour to illustrate it by the diagrams in the Plate accompanying this paper, representing four of the most common forms in which the typical nodular flints are met with in the Chalk, all peculiarities as regards external form being of course dispensed with as irrelevant to the present inquiry. For this reason each of the four nodules is supposed to have been more or less spherical (a condition, by the way, in which they are not unfrequently met with), and to have been split in half, so as to exhibit the flat and broken surface of one of the hemispheres.

In figure 1 we have a solid mass of typical black flint, surrounded exteriorly by a whitish crust or layer, the thickness of which is immaterial, inasmuch as it depends almost entirely on the degree of comminution and purity of the deposit in the spot at which it was formed. The portion which is now a mass of the typical black flint (marked B in all the figures) consisted originally of an accumulation of effete sponge-spicules and network, which, immediately after the death of the parent sponge to which they belonged, became loosely distributed within the substance of the also effete investing protoplasmic *nidus* *. Here they would be retained, more or less free from contact with sea-water, owing to the insolubility and coherence of the protoplasm, and would in due time yield to the powerful solvent influence of this substance (an influence which is at its maximum when exerted between substances that are colloidal), and eventually, by parting with their hydration in obedience to the law which governs these bodies, as their state of pectization became more perfect, would become consolidated into black flint.

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* "Effete" is not meant to denote a state of decomposition in the common acceptation of the word, inasmuch as every known fact tends to show that no such process takes place at profound depths in the ocean. Disintegration (*i. e.* tumbling to pieces) may, and no doubt does, take place, either in obedience to mechanical, chemical, or molecular forces, under the operation of which dead organic matter is enabled to enter into new combinations. This distinction is more important than it at first sight appears to be, since there is reason to believe that in such an elementary substance as sponge-protoplasm, and likewise in the examples known to every algologist, in which the development of a protoplasmic *nidus* or "*thallus*" is often so enormous in comparison with the dimensions and apparent capabilities of secretion of the organisms producing it, that it is extremely difficult to understand by what subtle or simple function (if it be indeed simple) such a massive adjunct can be produced and maintained for lengthened periods. The singularly rapid disruption of this adjunct, following upon the death of the organism of which it formed a part, furnishes one of the most instructive and significant commentaries we could desire upon the complete

Wherein, then, does the external whitish layer or crust of the nodule, and which also forms a crust or coating over the surface of the tabular layers of flint, differ in its mode of formation from that I have just been describing—namely, of the central mass of black flint? The explanation, I contend, is both simple and conclusive. At this stage of the formation of the nodular mass (not in point of time, but of material) replacement of the carbonate of lime by silica, *rarely, if ever, a complete process* *, comes into operation. An examination of sections of nodules embracing both a portion of the true flint and of its outer investing crust of *chert* will show that the transition from pure flint to well-pronounced chert is a gradual one, so gradual, indeed, that it would often be difficult, were not a difference of colour apparent, to recognize it, except by the impairment of the vitreous character, conchoidal fracture, and translucence which distinguish the flint from the crust of chert. Seen, however, as a section under the microscope, it is always visible. On the outer aspect of the cherty crust, on the other hand, there is no gradation observable either as regards colour or texture; for, although in nearly every nodular mass a certain quantity of unmetamorphosed chalk is closely adherent to it externally, a very little trouble will show that not a trace of siliceous percolation has extended beyond the peri-

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dependence of organic matter for its continuance, *as living matter*, upon the unknown quantity we call life. A mere breath destroys the link that binds together the animate and inanimate; and, as if eager to regain the sway they once enjoyed, when life "was not," the material forces of nature set about their normal task of disintegrating and reconstructing the elements which had for a time so successfully set them at defiance. If we extend this conception (and there is no reasonable ground for saying we have no warrant for so doing) to the stupendous development of sponge-life at the bed of the ocean, we shall not experience difficulty in comprehending how the silica and the protoplasm of the sponge, which respected each other's rights so long as the vital force presided over them, should, under the now unrestrained action of their powerful combining tendencies, interact upon each other in the way that has here been indicated.

* Mr. Sollas (at p. 449 of his paper) speaks of the white outer crust of the flints as "an incompletely silicified *layer of chalk*."

phery of the cherty wall, the adhesion of the cretaceous particles being due solely to their having become imbedded here and there, while the flinty mass was yet in an unconsolidated state, into little pits or cavities formed by the pressure of the cretaceous particles themselves, or into other equally accidental irregularities of the surface of the nascent nodule. The adherence of any portion of chalk to the nodule is a mere mechanical adherence arising out of the grip thus secured.

Now, according to the replacement theory, the entire mass of black flint was at one time a mass of calcareous ooze, which, becoming impregnated with a fluid aqueous solution of silica, became gradually silicified. Had this really taken place, one of two things must have happened: either the replacement of the calcareous material must have begun from some central point or points, by the admission of the siliceous solution into the centre of the mass through some channels which communicated with the surrounding medium—in which case a period must have arrived at which the external layer of the mass undergoing silicification must also have come under the influence of the replacing siliceous fluid and have in its turn become completely converted into black flint, the replacement thus extending radially from the centre of the mass to its periphery; or the replacement must have taken place from without and extended centrewards. It will be obvious, however, that under the latter supposition the outer coating must of necessity have been the first portion of the mass to be converted into flint. But it is almost needless to observe that in neither case is the theory of replacement borne out, inasmuch as in the first-named case the outer coating must sometimes, at least, have been converted into black flint—a condition in which it is never found; and in the second case, the silicification having begun from the periphery towards the centre, nodules must occasionally have been met with in which a coating of black flint (*not possessing a cherty external layer*) surrounded the yet unmetamorphosed central calcareous mass—another condition in which we never find it unless under the wholly exceptional circumstances where the nodule has, after separation from its chalky matrix, undergone attrition.

In the early nascent state of each nodule no chemical replacement of mineral for mineral has taken place on either side—the extensions of the colloidal siliceous jelly, and the intervening masses of calcareous deposit interlacing mechanically, and changing their relative boundaries only in obedience to the slow contraction going on in the colloidal mass towards its own centre or a centre or *point d'appui* consisting of some shell or other foreign substance that happened to come in the way and became thus accidentally enveloped either partially or wholly. According to Mr. Graham, "a dominating quality of colloids is the tendency of their particles to *adhere, aggregate, and contract.* In *the jelly itself the specific contraction or synœresis still proceeds, causing separation of water with a division into a clot and serum, and ending in the production of a hard stony mass of vitreous structure*" (Graham, "On Silicic Acid and other Colloids," Proc. Roy. Soc. vol. xiii. no. 65, June 1864, p. 336).

Here, then, is the key to my hypothesis, and, as I conceive, proof that the characteristic features, including the stratification and nodulation of the flints, are due to the inherent properties of the double colloid formed by the intense disposition of the colloidal protoplasm to enter into mechanical union (as in the case of glycerine and water) with the organic silica of the sponge-spicules and network—this tendency dating, however, *only* from the period when they ceased to be integral portions of a living structure and had already become only its residuary substances.

Having now explained, but still too cursorily to admit of my producing all the evidence that could be adduced in support of my view, the processes whereby the nodules and tabular layers of flint and the cherty varieties are formed, from the earliest to the latest stage of their nascent condition, it remains for me to connect these with my hypothesis in such a manner as to show:—firstly, the adequacy of the hypothesis to account not for one, or two, but for all the distinguishing features of the flint-formation as it now presents itself in the Chalk; and, secondly, in what respects the replacement and other theories that have been proposed must be considered faulty and insufficient to account for any thing more than the formation at the bed of the ocean of an impure flint, and the silicification of certain calcareous-shelled creatures which are entombed in the chalk and flint. I cannot secure this end more readily and, under existing circumstances, more appropriately than by quoting such portions of my former paper as bear on my hypothesis. But for the reasons assigned I should, of course, have been content to append references to the pages in question.

Referring to the insufficiency of the hypothesis previously offered in explanation of the Flint-formation, I asked:—

"Whence, then, did all the silica come? Why is it almost invariably found existing in layers parallel to the stratification of the Chalk? And what has really been its history, from first to last?

"It is to these questions that I hope, on the present occasion, to be able to furnish such answers as shall, at all events, form the groundwork of a good working hypothesis, and one capable of further elaboration as time and opportunity permit. Meanwhile I may be allowed to state that the conclusions arrived at by me have their origin in the assumption that, in the nearly total elimination of the organic silica from the organic carbonate of lime, in the almost constant aggregation of the colloid silica around some foreign body, in the ultimate consolidation of the colloid material into nodular masses or more or less continuous sheets, in the stratification of these masses and sheets, and, collaterally, in the perfectly preserved state of many of the Cretaceous fossils, are to be discerned the successive stages of a metamorphic action, whereby the protoplasmic matter and silica present on the sea-bed, after having first passed through an organic phase capable of resisting disintegration and decay, became once more amenable to those purely material forces in obedience to which they entered upon their new and secondary phase as Flints *.

"But even yet the chain of metamorphic action must have remained incomplete but for the manifest connexion which I was fortunately enabled, in 1860, to trace out between each of the successive stages referred to and a condition of things at the sea-bed then for the first time noticed—namely, that the entire mass of animal life there present is confined to the immediate surface-layer of the muddy deposit, alternating periods being thereby established, during which one of the two predominant animal types (Foraminifera and Sponges) gradually overwhelms and crushes out the other over indefinite local areas, the strata of chalk in the one case, and the intercalated flint-beds in the other, being the issue of these contests.

"Should it be asked, Why, then, do we find so striking a lithological difference between the Chalk and the Atlantic mud? the answer is, because our specimens of the mud represent only the constituent materials forthcoming at a depth of a few inches beneath the surface, where, if my hypothesis be correct, there must needs be accumulated nearly the whole of the silica. Whereas, were it possible to obtain specimens, say, from a depth of even a few feet, we should find that all, save the small residuary portion detected by analysis in the Chalk, had in like manner been eliminated from the mud."

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* "Much valuable information 'on Quartz and other Forms of Silica' will be found in a paper bearing this title, from the pen of Prof. Rupert Jones, F.R.S. Unfortunately I was unable to avail myself of it, being unaware of its existence until the present communication had been laid before the Geological Society."

"A very important fact has to be here noticed in relation to the siliceous materials which are supposed to be normally and uniformly distributed throughout the substance of the calcareous mud at the period of its deposition on the sea-bed. In order to understand the full significance of this fact, it is indispensable to recollect that, whereas the carbonate of lime of the effete Globigerine and other foraminiferous shells is to a certain extent redissolved in the water charged with an excess of carbonic acid, and the amount thus abstracted is too insignificant to produce any material diminution in the mass of the calcareous deposit, nearly the whole of the organic, and probably a not inconsiderable proportion of the inorganic silica which has been found present in some specimens of the Atlantic mud, is dissolved under the conditions that prevail. For, whereas the calcareous matter is furnished partly from the débris of Foraminifera which pass their existence only at the bottom of the ocean, and partly from such as live at the surface and subside to the bottom only when dead, *the whole of the silex-secreting organisms, with the solitary exception of the sponges, subside to the bottom only after death.* The result is, that the *whole* of the organic silica, the moment it reaches the bottom, comes into contact with the protoplasmic layer and is retained by it. *Hence the quantity present in every sample of mud obtained (as all our samples hitherto have been) by a mere dip into the superficial stratum of a few inches in depth, does not fairly represent the percentage of silica contained and supposed to be equally distributed in the substrata, but only the accumulated amount of that substance which has been getting accessions for an indefinite period from the superincumbent waters.*

"In the case of the sponges that occur in such numbers on every square yard of the calcareous mud, and live more or less imbedded in the soft and luxuriantly developed nidus of their own protoplasm, the result described must necessarily take place in a still more signal degree, since every spicule, and every particle of their siliceous débris, is not only formed but accumulated within this protoplasmic environment. Therefore, instead of there being from 25 to 35 per cent. of silica, soluble and insoluble, in the calcareous mud, at a depth, say, of eighteen or twenty-four inches below the surface there is in all probability not more than is to be met with in an average specimen of white chalk.

"If we follow out to its legitimate issue a continuance of such conditions as have been here described, it is obvious that a period must arrive when the protoplasmic masses (which, owing to their inferior specific gravity, always occupy this position in relation to the calcareous mud, upon which they may be said to float so as to form an intermediate stratum between them and the superincumbent water) will become, if not supersaturated with silica, at all events so highly charged with it in a now colloid state more and more closely approaching coagulation, as eventually to asphyxiate, so to speak, the very organisms which have produced them.

"If we turn to the less prominent, because negative, conditions that prevail at the sea-bed, we shall perceive that they are of a kind specially favourable for securing uniformity of results, both as regards the time occupied in their completion and the nature of the changes which are effected by them. Thus we know that the abyssal waters closely bordering on the sea-bed itself are, in the majority of cases, in a state so nearly approaching perfect quiescence, that no current of sufficient energy exists to divert from their downward course particles of matter so light and feathery as to have taken probably many weeks, if not months, to sink down from the surface of the sea to their final resting-place at the bottom. On the other hand, there is nothing as yet known that could lead to the inference that the periods required for the deposition and consolidation of each succeeding stratum of chalk, and its accompanying stratum of flints, bear any proportion to those gradual and more rarely recurring secular changes in the direction of the great oceanic currents which (to repeat Sir Charles Lyell's words) favour at one time in the same area a supply of calcareous, and at another of siliceous matter; whilst, as a natural consequence, the prevailing uniformity of the physical conditions must inevitably engender a corresponding uniformity and simultaneousness in the development, growth, and final death and decay of the various lower forms of life that are under its influence. If this be true, we might expect that over large areas of the calcareous sea-bed a very preponderating number of the sponges would, almost simultaneously, spring into existence from the germs or gemmules left by a preceding generation, and as simultaneously multiply and die, to be succeeded in turn by another generation, and so on. We are thus furnished with an auxiliary, though (as I shall presently show) by no means the most important, factor in determining the simultaneous production of the flint nodules and sheets over extended horizontal areas."

"The stratification of the flints is due to the fact, already touched upon in a previous page, that nearly the whole of the silex derived from the Sponges on the one hand, and the continual subsidence of minute dead siliceous organisms on the other, is retained in the general protoplasmic layer, which

I have shown maintains its position on the immediate surface of the calcareous deposit, and gradually dissolves the silex. This layer, in virtue of its inferior specific gravity, rises with every increase in the thickness of the deposit, until at last the supersaturation of the protoplasmic masses with silex takes place, and the first step towards the consolidation into flint is accomplished—the continuity of sponge-life, and of the various other forms which tenant the calcareous areas, being secured through the oozy spaces which separate the sponge-beds, and thus admit of both adult and larval forms having free access to the overlying stratum of water.

"That the predisposition of silica, itself in reality a colloid, to form colloidal combinations with albuminous and other materials was known long before deep-sea exploration was dreamt of, is a well-known historical fact; it has been alluded to by most of the writers who have attempted an explanation of the mode of formation of the flints. But the various conditions that present themselves, from the earliest elimination of the silica from the sea-water to the period when it becomes finally consolidated, have never, that I am aware, been consecutively followed out.

"But that the colloidal *idiosyncrasy* of silica performed a much more important function in the phenomena connected with the flints than has heretofore been supposed, appears to me to be indicated by the evidence of the almost perfect incorporation of the organic silica with a colloid material, the unique *Amœbiform* nodulation of the flints, and its homogeneousness, whether occurring in nodules, in continuous sheets parallel to the stratification, or as sluggish overflows into fissures in the Chalk. But for a very highly developed colloidal condition of the materials, these peculiarities could not, I conceive, have presented themselves so uniformly throughout the formation. From a mere aqueous solution the deposit of silica would have exhibited totally different characters: there would have been a general infiltration into the substance of the chalk, the particles of which would thereby have been cemented together, so as to form a siliceous limestone; the various minute organic forms in which the silica showed itself, though, no doubt, capable of solution to a limited extent in water charged more or less highly with carbonic acid, and aided perhaps by the stupendous pressure, would have occasionally left more pronounced traces of their original structure than is observable in the body of the flints; probably all the fossils would have been either infiltrated with silica, or a substitution of that substance would have taken place even more frequently than we find it; there would have been no signs of the specific contractility pertaining to colloidal silicic acid; the resulting siliceous mineral, instead of appearing, when not rendered cherty by insoluble matter, as '*a colloidal glassy hyalite*,' would have presented itself either as compact quartz, or possibly as an alkaline silicate; and, lastly, there would have been wanting the evidence of the greater portion of the siliceous material having been, as it were, continuously waylaid and absorbed, as it descended from the surface of the ocean, into the colloidal protoplasmic mass resting upon the immediate upper surface of the calcareous deposit.

"In conclusion, I beg to express a hope that, although the length already attained by the present communication has debarred me from bringing forward a number of important facts and observations which would have materially strengthened my arguments, considering the complex nature of the inquiry and the special difficulties belonging to it, the following conclusions have, on the whole, been fairly sustained:— 1. That the silica of the flints is derived mainly from the sponge-beds and sponge-fields which exist in immense profusion over the areas occupied by the Globigerine or calcareous 'ooze.' 2. That the deep-sea sponges, with their environment of protoplasmic matter, constitute by far the most important and essential factors in the production and stratification of the flints. 3. That, whereas nearly the whole of the carbonate of lime, derived partly from Foraminifera and other organisms that have lived and died at the bottom, and partly from such as have subsided to the bottom only after death, goes to build up the calcareous stratum, nearly the whole of the silica, whether derived from the deep-sea sponges or from surface Protozoa, goes to form the flints. 4. That the sponges are the only really important contributors to the flint-formation that live and die at the sea-bed. 5. That the flints are just as much an organic product as the Chalk itself. 6. That the stratification of the flint is the immediate result of all sessile Protozoan life being confined to the superficial layer of the muddy deposits. 7. That the substance which received the name of '*Bathybius*,' and was declared to be an independent living Moneron, is, in reality, sponge-protoplasm. 8. That no valid *lithological* distinction exists between the Chalk and the calcareous mud of the Atlantic; and *pro tanto*, therefore, the calcareous mud may be, and in all probability is, 'a continuation of *the* Chalk formation.'"

The history of *Bathybius* is too well known to the scientific world to need resuscitation in this place. Suffice it, therefore, to say that Sir Wyville Thomson and Dr. Carpenter found what they conceived to be vast masses of it in dredging in the North Atlantic, at the same time that they discovered vast numbers of vitreous sponges whose root-fibres and spicules were densely mixed up with it "like hairs in mortar." The deep-sea explorations on board the 'Challenger' confirmed the existence over other areas of the ocean besides the North Atlantic, where they had first been found, of like vast accumulations of sponges. On this all but conclusive evidence I ventured to assume that *Bathybius*, though not an independent living thing, was not altogether a myth, but veritable sponge-protoplasm. I refer to the circumstance now solely in explanation of my having appended to this paper a figure (Pl. XI. fig. 5) of the so-called *Bathybius* (copied from Häckel's figure, a representation of which is to be found in Sir W. Thomson's 'Depths of the Sea,' p. 412), with a view to show what I mean by an *amœbiform outline*. It must be recollected, however, that, owing to the nature of the conditions to which a little viscid mass of the kind has unavoidably to be subjected when examined in the microscope, an undue amount of flattening-out must take place. It had evidently taken place in the specimen from which Haeckel's drawing was taken. Hence, as a perfectly typical specimen of an *Amœba*-like form, it might certainly be surpassed. But it has this extraordinary merit—that it is *not* a figure of *Amœba*, but, according to my interpretation, *of sponge-protoplasm itself*, which, for the purposes of the present inquiry, is infinitely more to the purpose than the best figure of an *Amœba* could possibly have been. At all events any one looking at it who is also familiar with the appearances exhibited by *Amœba* will, at a glance, recognize the identity in character, and have no difficulty in perceiving that, but for the abnormal flattening-out of the mass by compression just referred to, no more conclusive testimony could have been furnished of the tendency of an organic colloid, and notably of the material itself which is so largely concerned, according to my hypothesis, in the production and determination of the unique but nevertheless undefinable type of irregular form of the flint nodules, to assume the forms in question.

I would add that I have never said or written, because I have never so believed, that the *living* sponge-protoplasm has any thing to do with the flint-formation. It stands in the same direct relation to the living parent sponges as the protoplasmic investment of a group of Botryllidæ, adherent to a mass of rock, does to these organisms; or the gelatinous thallus, often of great comparative bulk, which surrounds some of the freshwater protophytes. It is only after the death of the sponge that the spicules, already resting within the protoplasmic mass, combine with it and pass through the phase which has already been described by me in a previous portion of this paper, and was pointed out at p. 72 of my former paper in the extract which will be found *antè*, p. 192. It only remains for me to mention that the "Coccoliths" which form so prominent a feature in Häckel's figure have, in reality, no connexion whatever with the protoplasmic mass in which they rest. This I maintained in a paper on the nature of the so-called "*Bathybius*" (Ann. & Mag. Nat. Hist., Nov. 1875, p. 325). No doubt Coccoliths, subsiding in the shape of *disjecta membra* of the parent Coccospheres from the surface-waters of the ocean which they inhabit, are constantly showered down in certain regions upon the sponge-fields on the sea-bed below. And when this is the case they no doubt ultimately undergo silicification by replacement, just as the Foraminifera do. But in all probability their extremely minute size and delicate structure, when so silicified, alone prevent us from detecting their spectral pseudomorphs in the flints, except when silicified outside, or, I should rather say, not imbedded directly within the substance, but within a cavity of the siliceous jelly. It is in this wise that they remain perfect in the flint-cavities along with the also free Foraminifera and other included objects.

Having stated, in a former part of these observations (p. 193), that the strict limitation of all sessile animal life present at the sea-bed to the immediate surface-layer of the muddy deposit, which is an invariable characteristic of the calcareous and probably all abyssal areas where living Protozoa are to be found, supplies the key to the whole of the unique phenomena observable in the flint formation, I will now endeavour to furnish an ideal picture of the condition under which the periodical formation of the strata of flint takes place. The Potstones of the Norwich Chalk appear to me to furnish a supplementary clue to the solution of this problem in spite of the still undetermined question whether they are the fossil remains of some Titanic sponge, like the Ventriculites. Fortunately it is sufficient to know that they were gigantic vitreous sponges, and must have grown one after another, each out of the inverted bosom of its immediate predecessor and parent. In this manner, and in this manner only, does it seem possible to explain their forming columnar assemblages, the height of each column, as seen in such faces of the chalk as are exposed to view, approaching 30 feet, each individual in each columnar series being about 3 feet in height. Hence they traverse several successive strata of chalk, passing directly through the interstratified flint-layers, and showing neither symptoms of exhaustion nor diminution of size at any part of their upward range.

The inference I would draw from these facts is that, whereas the living portion of each individual sponge was restricted to one plane, and that plane was determined by, and therefore followed, each rise in the level of the surrounding deposit, the growth being due to simple repetitive divisions of parts, and not to a process of reproduction, until the maximum height and perhaps maximum age attainable by each individual had been arrived at, the death of the parent Titan was synchronous with and perhaps dependent on the intervention of a true reproductive process, whereby a successor was produced, who was destined to pass through a similar cycle of existence. We may assume also that the enormous size of each individual, as compared with the other sponges and forms of animal life that passed their lives on the same sea-bed, would enable it to rear its head high enough above the general level, when occasion demanded, to enable it to continue its existence uninterruptedly while the organisms around were perishing.

The *stratification* of the flints in layers of nodules and tabular masses may, I conceive, be similarly accounted for. Starting with the facts that the calcareous areas of the ocean (which are the representatives of those in which the ancient chalk was deposited) consist of vast expanses of this deposit, interrupted only by sponge-fields and sponge-beds (the one living and flourishing in the intervals from which it had either gradually expelled or yielded up its ground to the other), what must have occurred, and be still occurring, over the calcareous sea-bed? As the sponges encroached (in virtue of their undoubtedly more rapid growth*) on the domains of the Foraminifera, the latter would, here and there, be overwhelmed by the protoplasmic masses and simply asphyxiated. The sponges would, in turn, encroach on each other, and eventually crush out and destroy some of their own kind—their siliceous remains, no longer restrained by vital forces, thenceforward becoming subject to material forces, and, as suggested in a previous portion of this paper, entering into colloidal combination with the protoplasm by which they were surrounded. Meanwhile Foraminiferal life would continue to multiply in all the vacant spaces. Small patches and masses of the ooze would be enveloped by masses of protoplasm; living organisms of various kinds would be similarly entrapped and entombed by the closing around and over them of the protoplasmic masses; and meanwhile a never-ceasing rain of minute calcareous- and siliceous-shelled organisms from the surface of the ocean would fall down upon the sea-bed, the protoplasmic and colloidal aggregations receiving their share, and allowing these foreign bodies to sink into their substance and become the bases of the future pseudomorphs of the flint.

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* Prof. Martin Duncan says, with reference to the slow rate at which deep-sea deposits are formed:—"With reference to the great thickness of deep-sea deposits, I have satisfied myself, from late researches, that the rate of deposition is exceedingly slow. Thus an electric cable was laid down in the *Globigerina*-ooze region; and six years after a considerable coral-growth had taken place on it. Some of the living calices were close above the cables; and therefore the deposit had been infinitesimal in that time. Again, there are slow-growing Echinoderms, Corals, and Spongida in place in many chalk series; and it is evident that the foraminiferal and sedimentary deposit was infinitely slower than their growth" (Anniversary Address Geol. Soc. London, 1877, by Prof. Martin Duncan, M.B., F.R.S., p. 44).

But whilst the Foraminifera, as they died off, would leave their remains on the spots where they died, and thus assist infinitesimally, but continuously, in building up the cretaceous deposit, each new brood being born, living, and dying on the surface of the sea-bed, and the races being kept up by those occupying the vacant spaces, the sponges as they died off would not leave their remains on the sea-bed itself, but those remains would be one after the other absorbed by and form part of the colloidal masses of protoplasm and silica clinging together, and floating, as it were, on the immediate surface of the sea-bed. This tendency of the colloidal masses of silica "to adhere, aggregate, and contract," their viscidity, immiscibility with the water, and the extreme difficulty with which they could be made to sink at all into the substance of the ooze, would enable them continuously to maintain a position immediately resting upon the subjacent deposit; and in this wise they would accumulate, and, by perpetual accessions of siliceous remains from without, gradually become saturated with silica.

But even yet certain conditions would have to be fulfilled before any thing like simultaneous molecular or chemical action could take place over vast areas so as to produce the stratification of the resultant siliceous masses.

Owing to the perfect stillness prevailing at the sea-bed, the total absence of currents, the nearly constant uniformity of temperature, and the perfect uniformity and constancy of all the other conditions prevailing there, together with the immense periods concerned in the deposition of the strata, there is every probability that the growth of the entire series of sponges occupying the area in which they flourish in the highest degree, owing to the uniformity of all the above conditions, would proceed *pari passu.* It would follow, therefore, as a natural consequence, that the time requisite for the growth and arrival at maturity of the whole series would, in like manner, become uniform. The uniformity, moreover, of the supply of food, inseparable from the nature of the case—nay, the physical necessity that in a vast fluid medium like the ocean diffusion would take place with unerring uniformity of all the inorganic and organic substances on which nutrition depends—would assist, if not actually enforce, a rate of growth uniform in the groups distributed over the same areas. And thus the various groups would necessarily arrive simultaneously at that stage of their being when their asphyxiation by the supercharging of their protoplasmic masses with silica would end their career.

If we reflect, moreover, that we are dealing with conditions that must have been equally real and effective ever since the period when the earliest flint-producing deposits began to be formed at all, we can hardly doubt that the law which governs the growth of the sponges at the bottom of the deep sea must have caused them to complete their first cycle in the history of the flint-bearing chalk within a certain cosmic period, and that, owing to the uniformity of the conditions which have ever since prevailed, there must have been an approximate uniformity in the completion of each cycle since that period.

As the result of these operations, extensive areas of the calcareous sea-bed would, after a certain period, be simultaneously covered with protoplasm supersaturated with silica in its gelatinous condition, and a constant coalescence and tearing asunder of portions of the masses would take place, owing partly to their inherent contractility and diminution in volume through the expulsion of their combined water. Judging from what is known of the time necessary to bring about the change in silica from the gelatinous to the nearly perfectly anhydrous state, when it may be said to become finally consolidated into a hard, stony mass, it is not improbable that the process would not be a very protracted one, even when conducted on the vast scale referred to—a fact, if it be one, which would materially decrease the possibility of the extinction of the minute forms of life that build up the calcareous deposits. They would perpetuate their species in the intervals unoccupied by the nascent flint-masses, and gradually entomb them. On the other hand, the sponges would perpetuate their species by gemmules distributed over the general surface of the sea-bed, which would settle and develop wherever there were vacant areas and favourable conditions. In those tracts where the sponge-fields were altogether predominant, the dense colloidal areas, viscid and coherent enough to prevent their flowing out laterally, would become consolidated into tabular sheets, more or less unbroken, inasmuch as their contractility would exert itself chiefly in decreasing their thickness, as the expulsion of the combined water would go on uninterruptedly over their entire surfaces. On the other hand, in those tracts in which Sponge and Foraminiferal life had been split up into small contiguous patches, or the sponges occupied only sparsely scattered plots, the nodular flints would form, and be correspondingly distributed through the calcareous bed. It is here that the powerful contractile power resident in the colloidal masses would exert itself most freely on all sides, every little irregularity of surface caused by living or dead animal structures &c. tending still further to break up the masses, which, during their tearing asunder, would assume the *amœbiform* outlines which have been so often referred to by me as specially characteristic of animal protoplasm or albumen, and which may, to a certain extent, be seen when fresh albumen is mixed with cold water and gently shaken up, and then allowed to settle. That protoplasm—*the* protoplasm of the deep-sea sponges—does veritably assume these forms is an indisputable fact, attested by Häckel and Sir Wyville Thomson. I had myself once seen this material off the south-east coast of Greenland, in a sounding taken at a depth of nearly a couple of thousand fathoms, in which I found the minute sponge which Mr. Perceval Wright named after me. But I had not any idea at the time, or until many years afterwards, what the extraordinary glairy substance pervading the mud really was; and consequently I threw away the only chance I have had of seeing it in its perfectly recent stage.

It is a remarkable circumstance that, throughout the long cruise of the 'Challenger,' nothing whatever should have been discovered which might throw some light on the formation of the flints at the sea-bottom. Constant mention has been made of the immense abundance, in certain regions, of sponges; but I am not aware that any dead shell of a mollusk or echinoderm was found in the dredgings, the interior of which was filled up with colloid silica, or silica in an already consolidated state. One would have thought that, amongst the almost countless number of shells landed on the deck of the ship, whether from calcareous or siliceous bottoms, some trace of incipient fossilization or flint-formation must have turned up. But, on carefully considering the matter, it becomes obvious that the chances are a million to one, comparing human with cosmical periods, against the 'Challenger' dredge coming across any portion of the ocean in which that special stage in the flint-formation had been reached, when the consolidation of the pectous silica was just commencing, or just being completed. In all such operations of nature, we are too apt to forget that, whilst time and money are said to be almost convertible terms in human affairs, both time and money are unknown at the bottom of the sea, except when man has been either foolish or unfortunate enough to leave there all that remains to him of these good things.

EXPLANATION OF PLATE XI.

Figures 1 to 4 are diagrammatic representations of nodular masses of black flint from the Upper or White Chalk (as seen in section), and are intended to illustrate the mode of formation of the flint, its outer investing layer of chert, and other points referred to below.

Fig. 1 represents the section of a spherical nodule of solid black flint enveloped in its white or greyish-coloured outer layer of chert.

Fig. 2 represents the section of a similar spherical nodule, in which the central portion of a mass of calcareous and possibly some siliceous débris had been surrounded by the colloidal mass of protoplasm and silica, the contraction of which upon itself had been so great as to compress into a closely compacted mass the contained materials, these having been converted into chert by the incomplete replacement of their carbonate of lime by silica.

Fig. 3. A similar section to the last, in which, however, the included material was insufficient to occupy the whole cavity, the vacant portions having in all probability been occupied originally by water.

Fig. 4. A similar section to no. 2, having in the middle of its central cherty mass a drusy cavity lined with crystals of pure quartz.

Fig. 5 is a facsimile of the figure given by Sir Wyville Thomson (at p. 412 of his 'Depths of the Sea') of "*Bathybius*," as taken from Prof. Hackel's original drawing of a specimen examined by him under the microscope, in a supposed living condition. This figure is introduced here, not because I have ever believed in the existence of *Bathybius* as an independent structure, but because I regard the substance to which that name was given as simple sponge-protoplasm, in order to show that even in the dead state of this substance it is capable of exhibiting *amœbiform* outlines when subjected to gentle pressure.

BIBLIOGRAPHICAL NOTICE.

A Monograph of the Silurian Fossils of the Girvan District in Ayrshire. By H. A. NICHOLSON, M.D. &c., and R. ETHERIDGE, Jun., Esq., F.G.S., &c. Fasciculus III. 8vo. London and Edinburgh: Blackwood & Son, 1880.

THIS part completes the first volume of a first-rate palæontological work, the result of enthusiastic labour on the part of the authors, who are fully conversant with their subject. Supplemental matter (derived mainly from new collections made in Ayrshire, and partly from further knowledge acquired in the progress of the work) forms a large part of this Fasciculus, namely the chapters on some of the fossil Protozoa, Cœlenterata (tabulate corals), and Crustacea, from Girvan. Some Annelidan remains, and several so-called "Worm-tracks," or trails and marks due to Crustaceans, Mollusks, and other animals besides Worms (as the authors now recognize them), are treated of; and various Echinoderms (Asteroidea and Crinoidea) are carefully described. These fossils are well illustrated in nine plates. The printing, paper, and plates are good. A careful index for the volume is appended; and altogether the authors may well be proud of their elegant and useful volume.

MISCELLANEOUS.

On the Existence of a Reptile of the Ophidian Type in the Beds with Ostrea columba, *of the Charente.* By M. H. E. SAUVAGE.

THE Ophidian type, the maximum development of which is at the present epoch, seemed to make its first appearance at the base of the Tertiary, in the genera *Palæophis* and *Palerya*, discovered by Owen in the London Clay. Fossil snakes, however, were known only by a few rare species found at Sheppey, in the phosphorites of Quercy, and in the Miocene of Sansan. Gervais had figured (but without giving it a name) the vertebra of an Ophidian derived from the sandstones which, at the island of Aix, are above the Cretaceous lignitiferous clays. M. Trémaux de Rochebrune, has since collected vertebræ which enable us to assert the presence of the serpent type as long ago as the Cenomanian epoch, in the Carentonian stage, the sands with *Ostrea columba* of the forest of Basseau in the Charente.

These vertebræ, which belong to the middle region of the body, are 0·013 metre high and 0·014 metre long, and indicate an animal of about 3 metres. The length is equal to the breadth at the level of the costal apophysis; so that the vertebra is strong and thickset. The articular condyle is supported by a very short neck; the articular cavity is circular, such as we find in the Boedonians. The neural canal is narrow, as in the Crotalians; and its section is triangular. The anterior face is broad, the diapophysis and zygosphene projecting but little. As in the Typhlopians, the parapophysis is reduced to a feeble tubercle, which joins with the diapophysis by a prominent line; the zygapophysis is inclined downwards, backwards, and inwards. The Boas and Pythons have the tubercle for the insertion of the rib placed very near the anterior margin of the centrum; this is also the case with the Cretaceous serpent. When we examine the vertebræ from above, the costal tubercle appears immediately outside of and a little behind the diapophysis, reminding us of what is seen in *Acrochordus*. The process of the neural spine is united to the diapophysis by a slightly excavated line. The neurapophysis is robust, and the neural spine broad, tolerably high, and flattened at its upper margin, which must have given attachment to a powerful ligament; this neural spine occupies the greater part of the length of the centrum, as in the Crotalians. The inferior surface of the centrum is flattened, which recalls the vertebra of the Amphisbænians; we may also recognize the absence of any hypapophysial tubercle, as in the Typhlopians, which, as is well known, form the passage from the Ophidians to the Saurians.

The Cretaceous serpent, at present the most ancient known Ophidian, presents such manifold analogies that it is not possible to refer it to one rather than another of the great divisions accepted for existing snakes; it indicates the existence as early as the Cenomanian epoch of a peculiar genus, which we propose to name *Simoliophis*, giving the species the denomination *S. Rochebruni*, from the name of the zealous naturalist to whom the discovery of this interesting type is due.—*Comptes Rendus*, Oct. 18, 1880, p. 671.

On some Arctic Holothurida.

By MM. D. C. Danielssen and J. Koren.

Among the Holothurida obtained by the Norwegian arctic expedition of 1878, the authors notice some new forms, and indicate certain points in the synonymy of previously described species. One of the former is described as the type of a new genus under the name of *Kolga hyalina*, the generic name being derived from that of one of the daughters of the goddess of the sea in the old northern mythology. The genus belongs to Théel's family Elpididæ, and is characterized as follows:—

Genus Kolga, g. n.

Body bilateral. A buccal disk, furnished with ten tentacles, turned towards the ventral surface. Anal aperture on the dorsal surface (near the posterior extremity). On the anterior part of the back a projecting collar, furnished with papillæ. Just in front of this (and usually concealed by it) are two apertures, one for the generative organs, the other for the stone-canal. Feet on both sides of the body and around its posterior extremity. Sexes separate. No intestinal appendages (lungs).

Kolga hyalina, sp. n.

Body 50 millims. long, 15–20 high, and 12–15 broad. Back very convex; on the collar six transversely arranged papillæ, of which the two middlemost are the longest. Sixteen long, thick, almost retractile feet, five on each side and six around the posterior end. Skin of the body diaphanous. Tentacles five-lobed, each lobe trifid.

Hab. Station 295, 71° 59′ N. lat., 11° 40′ E. long., at a depth of 1110 fathoms, temperature $-1°.3$ C., in *Biloculina*-ooze; Station 303, 75° 12′ N. lat., 3° 2′ E. long., at a depth of 1200 fathoms, temperature −1°·6 C., in brown mud. Feeds chiefly upon Diatoms and Foraminifera, swallowing the fine mud in which these creatures live in extraordinary abundance. The skin is transparent with a whitish tinge, so that in places where it is compressed it appears quite white. The five-lobed leaf of the tentacles, especially the part fringed with spicules, is deep orange-yellow. Buccal disk orange-yellow, with a darker, nearly brown ring round the mouth.

Myriotrochus Rinkii, Steenstrup*.

This species has been described under the same name by Lutken†, Stimpson‡, Selenka§, and Semper‖; but Théel's *Myriotrochus Rinkii*, from Nova Zembla¶, is regarded by MM. Koren and Danielssen as identical with *Chirodota brevis*, Huxley**, of which *Oligotrochus vitreus*, M. Sars††, is also a synonym.

ACANTHOTROCHUS, g. n.

Body cylindrical, apodal, rounded at the posterior extremity. Sexes separate; no intestinal appendages (organs of respiration). Skin furnished with two kinds of differently formed calcareous wheels. The one kind has winged radii, and teeth issuing from the inner margin of the periphery; the other kind of wheel is more than twice as large, and has also winged radii; but from the outer margin of the periphery there spring long teeth turned inwards. Twelve digitate tentacles, which can be concealed in the body.

Acanthotrochus mirabilis, sp. n.

Body 10–12 millims. long, cylindrical, widened and rounded off at the hinder extremity. Mouth and anal aperture central. Skin transparent, beset throughout with two different kinds of wheels. Those of one kind are stalked, small, furnished usually with eleven radii, and from the inner margin of the periphery spring generally two triangular teeth between each two radii. The larger wheels have usually 8–11 radii; and from the outer margin of the periphery spring long pointed teeth, equal in number to the radii. Twelve tentacles, furnished with three divided digitate leaves. Five longitudinal muscles. Skin in the living animal perfectly transparent, with fine glistening points, which under the lens are found to be calcareous wheels. The margins of the tentacles brownish.

Hab. Station 283, 73° 47′ N. lat., 14° 21′ E. long., in 767 fathoms, temperature −1°·4 C., *Biloculina*-ooze; Station 295 (see *Kolga hyalina*); Station 312, 74° 54′ N. lat., 14° 53′ E. long., in 658 fathoms, temperature −1°·2 C., brown and green mud.

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* Vidensk. Meddel. naturh. Foren. Kjob. 1851, pp. 55–60.

† *Ibid.* 1857, p. 21.

‡ Synopsis Marine Invert. Arct. Exp., Proc. Acad. Nat. Sci. Phil. 1863, p. 138.

§ Zeitschr. f. wiss. Zool. xvii. (1867) p. 367.

‖ Reisen im Archip. der Phil., Holothuria, i. p. 24 (1867).

¶ Appendix to Sutherland's 'Journal of a Voyage to Baffin's Bay,' &c., vol. ii. p. 221 (1852).

** Note sur quelques Holothuries des Mers de la Nouvelle Zemble (Upsal, 1877).

†† Vidensk. Selsk. Forhandl. 1865, p. 200, and in 'Fauna littoralis Norvegiæ,' Heft 3, p. 49.

Molpadia borealis, M. Sars, with which *M. violacea*, Studer, is probably identical, is referred by the authors to their genus *Trochostoma*, as also *Haplodactyla arctica*, Marenzeller. Allied to these is a new genus with two new species.

ANKYRODERMA, g. n.

Body cylindrical. Anterior end transversely cut off. Buccal disk furnished with fifteen tubular processes, alternating with fifteen oblong depressions, in which there are fifteen papilliform tentacles. The posterior extremity produced into a tail-like process. Cloacal aperture surrounded by five papillæ. Skin furnished with perforated papillæ, together with singular calcareous bodies consisting of five to six spatulate calcareous rods arranged in a stellate form, from the centre of which rises a calcareous anchor. No feet. Two intestinal appendages.

Ankyroderma Jeffreysii, sp. n.

Body elongated, cylindrical. Caudiform process long. Tentacles extremely small, furnished with three papillæ, of which the middle one is the largest. Genital papilla large, prominent. Calcareous bodies in the skin of three forms,—anchors attached to spatuliform calcareous rods, perforated calcareous plates with crowns, and oval claret-coloured bodies, placed in groups. The colour of the skin in the living animal is greenish with a violet tinge from the scattered red points, or sometimes dark violet. The anterior end of the body has a white pentagonal ring, within which is the white buccal disk with white tentacles. The genital papilla in part yellowish white, in part full yellow; caudiform prolongation white.

Hab. Station 260, Porsangerfjord in 127 fathoms, temperature 3°·5 C., and 261 Tanafjord in 127 fathoms, temperature 2°·8 C., on a muddy bottom; Station 262, Tanafjord in 148 fathoms, temperature 1°·9 C., ooze; Station 372, 97° 59′ N. lat., 5° 40′ E. long., in 459 fathoms, temperature −1° C., on bluish-grey mud.

Ankyroderma affine, sp. n.

Body cylindrical. The caudiform process shorter than in the preceding. Tentacles extremely small, with three papillæ. Genital papilla not prominent. On the surface of the skin tolerably regular rows of anchors attached to spatuliform calcareous rods. Among these are some peculiar calcareous branches, from the common starting-point (central point) of which there rises either a three-knobbed crown or a long calcareous spicule, or some exceedingly variously formed perforated calcareous plates with crowns; and in the deeper layer of the skin a great quantity of colourless more or less rounded bodies consisting of a conglomerate of calcareous prisms. Skin greenish; buccal disk and caudal point white.

Hab. Station 290, 72° 27′ N. lat., 20° 51′ E. long., in 191 fathoms, temperature 3°·5 C., sandy clay.

The genus *Trochostoma*, Dan. & Kor., includes *T. Thomsonii*, D. & K., with no cloaca; and with cloaca *T. boreale*, M. Sars, *T. arcticum*, Marenz., and *T.* (*Molp.*) *ooliticum*, Pourt.—*Nyt Magazin für Naturv.* Bd. xxv. pp. 83–140, pls. i.–vi.

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XVIII.—*On some new or little-known Infusoria.*

By C. MERESCHKOWSKY.

[Plate XII.]

IN this article it is my intention to describe some new species of Infusoria that I have observed in the different seas that I have chanced to visit. There are two species from the White Sea, three others from the Black Sea, and two observed in the Bay of Naples. It is especially with the view of enriching our knowledge of the geographical distribution of the Infusoria that I publish these notes; it is also with this object that I undertake a revision of certain genera, such as *Trochilia* and *Acineta*, so far as the marine species are concerned.

Although want of time did not allow me to acquire more than a superficial knowledge of the Infusorial fauna of the Black Sea, I nevertheless see with satisfaction all the conclusions at which I arrived in my "Studien über Protozoa des nördlichen Russlands" more and more confirmed, as I have just shown in a recent note upon the Infusoria of the Black Sea*. There are already ten marine species, all more or less frequent in the Black Sea, that I have never met with in the White Sea; and there is not a single freshwater species observed in the Crimea or in the Caucasus that has not also been observed by me in the Arctic regions of Northern Russia. Thus the law that the marine Infusoria of different seas differ much more than the freshwater Infusoria of different countries finds a new confirmation in the Infusorial fauna of the Black Sea.

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* "Matériaux pour la faune des Infusoires de la Mer Noire," Travaux de la Société des Naturalistes à St. Pétersbourg, 1880.

All the other laws of the geographical distribution of the Infusoria established by me in the memoir above mentioned are likewise daily finding fresh confirmations; and I believe there is little change to be expected in this respect when the distribution of this class of organisms shall be studied with the same zeal and attention that is devoted to other classes.

I will now pass to the description of the new species.

Cothurnia pontica. (Pl. XII. figs. 4–6.)

Diagn. Concha superficie undulata insidet pediculo brevi; urceiformis, duobus rostris munita. Animal insidet pediculo triangulari, intus excavato.

Loc. Black Sea, Crimea, Livadia.

Descr. This is one of the prettiest species that I have ever seen of this genus, the forms of which are so numerous. The carapace has a very graceful pitcher-shape with the edges slightly turned out, and with two sides of the margin more elevated than the rest, which especially aids to give an elegant appearance to the whole animal. The surface of the carapace is not even, but covered with four or five not very strongly marked circular elevations. The carapace has scarcely any pedicle; it might therefore be placed among the sessile species; the little that can be taken for a peduncle is only the attenuated part of the base of the carapace, enclosing the peduncle of the animal itself, as is well shown in the figure (fig. 5). The peduncle of the animal is formed by an inferior small pad, which is perfectly solid, and a conical peduncle with its widest part turned upwards, where it is attached to the animal. This peduncle is not solid like the pad which serves as its base, but furnished with a cavity of the same conical form as the peduncle itself.

As to the animal, I have only seen its remains, already in a state of putrefaction. The carapace was attached to a Floridean Alga, apparently belonging to the genus *Ceramium*, which I found upon the shore of the Black Sea near Talta. The total length of the animal, or, more properly of the carapace, is 0·0171 millim., its breath is 0·007 millim.

Cothurnia socialis, A. Gruber. (Pl. XII. fig. 3.)

Loc. White Sea, Solowetzk Islands, at a depth of 2 metres.

Descr. I have waited so long with the description of this species, which I found in the White Sea in 1879, that it has at last been described by M. A. Gruber, not long since, under the name of *Cothurnia socialis.* And I do not regret it; for I should never have described the species with all the details given by M. Gruber; and, further, it would never have received from me the specific name "*socialis*," as I only came across it in St. Petersburg among Bryozoa preserved in alcohol, and I have only seen a single solitary individual, whilst the German zoologist has seen it in the living state and in great numbers. I have no doubt, however, on comparing my individual with the figures given by M. Gruber, that they belong to the same species. All the characteristic details of the species are present, except perhaps the coloration, which in the individual observed by me is not yellow, it is entirely colourless; but, as I have just remarked, the animal that I have observed is solitary, and therefore still very young, and it may very well be that the absence of colour is due simply to the youth of the animal. I would also call attention to the extreme regularity of its form.

The specimen that I have examined was attached to a Bryozoan by means of a rather long, slender, solid peduncle, slightly inflated at its base. The carapace, which is about the same length as the peduncle, is of an ovoid form, with a small conical process at the lower part, and with a funnel-shaped neck at the upper part. The carapace bears four very strongly marked circular striæ or grooves, dividing it into five parts or segments. The body of the animal is placed upon a small peduncle, which is only the continuation, in the interior of the carapace, of the exterior peduncle.

The following are some measurements of this marine species, which, apparently, is characteristic of the northern seas; for it is only in these that it has been found, by two observers:—

	millim.
Length of the carapace	0·084
Maximum breadth	0·035
Length of the peduncle	0·054

Tintinnus mediterraneus, sp. n.
(Pl. XII. figs. 1, 2.)

Diagn. Concha urceoli inflati forma, paulo longior quam latior, collo brevi lato, 4–5 striis annulatis.

Loc. Mediterranean Sea, Black Sea, Crimea, and Bay of Naples.

Descr. The carapace of the animal, which is all that I have had the opportunity of examining, is in the form of a wide, somewhat inflated vase, rounded or terminating in a point at the bottom, thus forming, as we shall see, two distinct varieties. At the upper part it narrows suddenly, forming a wide but not very long neck, the margins of which are not turned out. In the variety that I have observed in the Black Sea, the neck is a little narrower relatively to the total width of the carapace (Pl. XII. fig. 2), which causes the neck to be more accentuated; while in the other variety, from the Bay of Naples, the neck is almost as wide as the carapace (Pl. XII.* fig. 1), as may be seen by comparing the two figures here given.

The neck and the upper part of the carapace itself are adorned with slight rings, which are nothing but circular elevations or thickenings of the chitinous substance of the carapace. These circular striæ are four or five in number; and their arrangement is slightly different in the two varieties of the species that I have observed. In one of them, that from the Black Sea (fig. 2), the neck is ornamented with three rings, while the actual body of the carapace has only two; in the Neapolitan variety, on the contrary, there is only a single ring upon the neck, the others being placed upon the first third of the carapace itself (fig. 1). But the principal difference which distinguishes the two varieties is the form of the bottom of the carapace. Whilst in the specimen that I observed in the Black Sea the bottom is regularly rounded (fig. 2), that of the Neapolitan variety presents at the posterior extremity a rather long and regularly conical point. We should thus have two local varieties:—

1. Var. *pontica,* with the bottom of the carapace rounded. *Loc.* Black Sea, Crimea, Livadia.
2. Var. *neapolitana,* with the bottom terminating in a point. *Loc.* Bay of Naples.

This species, which is very easily distinguished by its form from all the other known species, is a marine species characterizing the fauna of the whole Mediterranean. It does not appear to be very rare; for I have found it in two different localities, namely the Black Sea and the Bay of Naples, although under somewhat different forms in the two places. Unfortunately I did not once happen to meet with the living animal; I have never seen more than the carapace.

The following are some measurements of this species (var. *pontica*):—

	millim.
Total length of the carapace	0·016
Maximum breadth	0·013
Length of the neck	0·002

Trochilia marina, sp. n. (Pl. XII. figs. 7–9.)

Diagn. Corpus ovale, in vertice paululum coangustatum, inferiore parte corrotundatum, dorsi superficie lævi.

Loc. Black Sea, Crimea, Livadia.

Descr. The slightly compressed body is regularly oval, except the anterior part, which is a little constricted and truncated; the rounded posterior part is furnished with a large and broad movable spine, excavated internally, and directed from right to left. The dorsal surface is more convex than the ventral, which is furnished with a space covered with cilia; this space is only half as wide as the body itself, and is of a slightly arcuated triangular form. On the dorsal surface there are two grooves, which run the whole length of the body, one on the right, the other on the left side, thus dividing the whole dorsal surface into three equal parts (Pl. XII. fig. 8). The single contractile vacuole is situated on the back, a little towards the left side. The oval nucleus is rather large, and situated on the right side. The mouth, with its bacilli, is very visible (Pl. XII. fig. 9).

This species, which is very well characterized by the form of the body, is not rare in the Black Sea, where I have often found it among the seaweeds covering the stones of the shore of the Crimea, near Livadia.

The genus *Trochilia,* first established by Dujardin, was exceptionally characterized by Stein by this peculiarity, that the cilia are not merely placed at the margins of the body, but occupy a larger or smaller portion of the ventral surface. The species hitherto known are a marine species (*Trochilia sigmoides**) found by Dujardin in the Mediterranean, and two freshwater species, *Trochilia palustris*, described by Stein†, and *T. polonica*, described by Wrzesniowski‡. Besides these three species and the fourth which I have just described, I think I may refer to the same genus another marine form from the Norwegian coast, described by Claparède and Lachmann§, in their 'Etudes sur les Infusoires et les Rhizopodes,' under the name of *Ægyria oliva.* As we may conclude from the excellent figure given of it by Claparède and Lachmann, this form must undoubtedly belong to the genus *Trochilia*, the greater part of the ventral surface being covered with cilia. It seems very strange that such an eminent student of the Infusoria as M. Stein did not direct attention to this form, and that in general he has not mentioned the work of Claparède and Lachmann in treating of the family Ervilina. I propose, therefore, to call the Infusorian in question *Trochilia oliva*. As for the *Trochilia polonica*, Wrzesn., found by M. Wrzesniowski in the fresh waters of Poland, that species has very little to distinguish it from *T. palustris*, Stein.

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* Dujardin, Hist. Nat. des Infusoires.

† Stein, Organismus, Abth. i. p. 118, Taf. ii. figs. 28, 30.

‡ Wrzesniowski, "Beobachtungen über Infusorien aus der Umgebung von Warschau," Zeitschr. für wiss. Zool. Bd. xx. p. 485, Taf. xxiii. fig. 37.

§ Claparède and Lachmann, 'Etudes sur les Infusoires et les Rhizopodes,' p. 289, pl. xv. figs. 14, 15.

With regard to the fifth species, which I have just described under the name of *Trochilia marina*, it is very distinct from all the other known species. It most nearly approaches *Trochilia oliva*, from which it is distinguished by the general form of the body, the two dorsal grooves, and the absence of the black pigment spot at the anterior part, which is so characteristic of *T. oliva*.

At present, therefore, we shall have five species of the genus *Trochilia*, three marine and two freshwater. Of the first three species, one (*T. oliva*) inhabits the northern seas, and the other two (*T. sigmoides* and *T. marina*) the seas of the south of Europe. Length of the animal 0·033 millim.

Acineta livadiana, sp. n.
(Pl. XII. fig. 10.)

Diagn. Concha ovalis, superiore parte, qua intus flectitur atque cum corpore conjungitur, truncata; pediculus tenuis, cylindricus, paulo quam corpus longior, scapo centrali.

Loc. Black Sea, Livadia, surface.

Descr. The carapace of the animal is regularly oval, except at the superior exteremity, where it is suddenly truncated, and furnished with a wide orifice, through which the suckers are seen to pass. The margins of the orifice bend in towards the interior of the carapace, and are produced there to some distance, forming a short interior tube. It is at the margin of this interior tube, and only at this margin, that the body of the animal is attached; in all other parts it remains freely suspended in the cavity of the carapace, occupying more than half its space. The body is almost regularly round, with its contours undulated and changing continually, these contours thus demonstrating the constant amœboid movement of the living animal. The protoplasm is strongly granular, which renders it rather opaque and at the same time makes it impossible to see the nucleus; but, on the other hand, a contractile vesicle situated in the ectosarcode is easily distinguished. The suckers, terminated by a knob, are not longer than the diameter of the body; they are about twenty-five in number, and arranged at the summit of the body in a single broad bundle.

The pedicle, which supports the body with its carapace, is not much longer than the carapace itself. It is cylindrical, slender, of uniform breadth, and furnished with a central axis composed of a material different from that of the surface, and apparently less dense. There is no enlargement of the pedicle either at the spot where it joins the carapace or where it is attached to the plant on which I observed the animal. It terminates suddenly, without forming a disk to facilitate fixation, such as is observed in nearly all the other species.

As to the systematic position of *Acineta livadiana*, it cannot be confounded with any other known marine species. The oval general form with the posterior part rounded is a very rare phenomenon among the *Acinetæ*, which, in general, have a more or less conical form. There are only *Acineta cothurnia*, Clap. & Lachm., and *Acineta compressa*, Clap. & Lachm., which have also an oval form and the bottom of their carapace rounded; but it is not possible to confound the species that I have just described with *A. cothurnia*, the latter having the carapace at its upper part terminated obliquely; and still less with *A. compressa*, which, as indicated by its name, has a strongly compressed form and the two corners truncated, which is not the case in *Acineta livadiana*.

The following are some measurements of the present species:—

	millim.
Length of the carapace	0·0256
Maximum breadth of the carapace	0·0192
Length of the peduncle	0·0320
Breadth of the peduncle	0·0012

The individual observed by me was attached to a branch of *Ceramium* floating on the surface of the Black Sea near Livadia (Talta).

Acineta Saifulæ, Mereschk. 1877*.
(Pl. XII. fig. 11.)

In a memoir published in Russian on the Protozoa of the north of Russia I described a new marine species of *Acineta* obtained from the White Sea. I will here give a translation of the description and a copy of the figure, taken from my Russian memoir.

The carapace is elongated, regularly conical, and not at all compressed; its form resembles that of a reversed sugar-loaf, the length of which is two or three times its greatest breadth. The carapace is borne upon a peduncle three times its length, of a cylindrical form, thin, and of equal thickness throughout. This peduncle is inserted into the carapace without causing any constriction at the point of union, as is the case, for example, in *Acineta patula*; it is straight in the normal state*, and hollow, the cavity of the peduncle being continued insensibly into that of the conical carapace without interruption. Close to the margin of the aperture of the carapace the walls of the latter are recurved suddenly inwards, and thus form a second carapace, situated in the interior of the first, and only united with the latter at the margin of the aperture. The second, or interior carapace occupies more than one third of the outer carapace, sometimes even one half of it, and is characterized by its rounded bottom and slightly turned-out margins. What further characterizes this species is a system of transverse circular striæ covering the whole surface of the exterior conical carapace; but as these striæ are extremely fine, they are only visible when a high magnifying-power is employed.

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* "Studies on the Protozoa of Northern Russia," p. 69, pl. ii. fig. 11, in Travaux de la Soc. des Naturalistes à St. Pétersb., 1877.

I have only seen the elongated oval body of *Acineta Saïfulæ* adhering to the margins of the carapace and freely suspended in the second carapace; but, as I have only observed this species when preserved in alcohol, it may be that the body of the living animal adheres to the whole surface of the inner carapace, which would thus perhaps not be easy to observe. A part of the body, in the form of a regular hemisphere, issues from the aperture of the carapace; and the whole of this part bears suckers (shortened by the action of alcohol), arranged regularly over the spherical surface. The small oval nucleus is situated in the middle, but nearer to the free half of the body. The protoplasm is, as usual, filled with fatty granules, and presents a slight yellowish coloration; the carapace and the peduncle are absolutely colourless.

The following measurements of this species have all been taken from individuals preserved in alcohol:—

	millim.
Length of the carapace	0·063
Maximum breadth	0·027
Length of the whole animal, including the peduncle	0·135
Breadth of the peduncle	0·0021

Loc. White Sea:—1. Bay of Onega, near the town of Rem, at a depth of 5 fathoms, on a muddy bottom, on the

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* The figure represents a curved peduncle; but this form is due to artificial compression, rendered permanent by the action of alcohol.

5th July, 1876; at this spot I met with it in great abundance attached to the Hydroid *Leptoscyphus Grigoriewi*, Mereschk. 2. The shore of Terski, in 66° 58′ N. lat. and 41° 20′ E. long., at a depth of 16 fathoms, on a bottom of gravel and shells.

Acineta Saïfulæ is a good species, easily distinguishable from all other known marine species. To show better the affinities of this species and the characters which distinguish it from the others, however, I am under the necessity of giving a short revision of all the marine species belonging to the genus *Acineta*. With those that I have just described there are in all ten of them, as follows:—

1. *Acineta tuberosa*, Ehr.
2. *A. patula*, Clap. & Lachm.
3. *A. cucullus*, Clap. & Lachm.
4. *A. cothurnia*, Clap. & Lachm.*
5. *A. compressa*, Clap. & Lachm.
6. *A. divisa*, Fraipont †.
7. *A. crenata*, Fraip.‡
8. *A. vorticelloides*, Fraip.§
9. *A. livadiana*, Mereschk.
10. *A. Saïfulæ*, Mereschk.

Of these ten species we have four (*Acineta patula*, *cucullus*, *compressa*, and *Saïfulæ*) which characterize the northern seas, such as the White Sea and the seas of the Norwegian coast. One species (*A. livadiana*) is characteristic of the southern seas (Black Sea). The other species are in part peculiar to the seas of the middle of Europe, in part more or less cosmopolitan (*A. tuberosa*). In comparing *Acineta Saïfulæ* with the other marine species it is necessary in the first place to exclude all the species with the bottom rounded, such as *A. cothurnia*, Clap. & Lachm., *A. compressa*, C. & L., and *A. livadiana*, Mereschk.; then among the rest, all having the conical form of the carapace, there can be no question about the following species—*A. tuberosa*, Ehr., and *A. compressa*, as having the body strongly compressed, *A. cothurnia*, C. & L., and *A. cucullus*, C. & L., the former having the margin divided into angular lobes, after the fashion of *Acineta mysta-*

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* Études sur les Infusoires et les Rhizopodes, p. 588; and Stein, Infus. p. 224, pl. iii. fig. 36.

† Recherches sur les Acinétiens de la côte d'Ostende, 1878, p. 25, pl. ii. fig. 1, &c.

‡ Fraipont, *l. c.* p. 89, pl. vi. figs. 1–11.

§ Fraipont, *l. c.* p. 92, pl. vi. figs. 12–17.

cina, and the latter having it strongly emarginate on one side (besides the suckers in two bundles). Nor can *Acineta Saïfulæ* be confounded with *A. patula*, on account of the difference in the form of the carapace, and the extreme fineness of the part of the peduncle where it unites with the carapace. The same difference of form distinguishes my species from *Acineta vorticelloides*, Fraip., with a very open and, "so to speak, rudimentary"*, carapace. Lastly, a crenulation upon the lateral surfaces and the irregularly-cut free margins of the carapace of *Acineta crenata*, Fraip., prevent its being confounded with our species. There only remains, therefore, *Acineta divisa*, Fraip., with which my species has the greatest analogy, as may be seen from the description given of it by Fraipont. The following, however, are the differences that may be found between the two species. In the first place, the general form of the body in *A. Saïfulæ* is usually much elongated, which is the case only exceptionally in *A. divisa*, the carapace of which is generally very wide open, approaching rather in form that of *A. patula*. Then the surface of *Acineta Saïfulæ* is always ornamented with transverse striæ, which is never the case in *A. divisa*. Lastly, the interior cup, the bottom of the second carapace, is much deeper in my species than in Fraipont's, which is in relation to the more elongated general form of the carapace in *Acineta Saïfulæ*.

To sum up, it may possibly be that we have to do here only with varieties of a single species, which would thus have to bear the name of *Acineta Saïfulæ*, as having been given earlier than the other name. But until we have more detailed observations I feel compelled to retain the two separate species.

Anisonema quadricostatum, sp. n.
(Pl. XII. fig. 12.)

Diagn. Body oval, strongly depressed, and furnished on the dorsal surface with four ribs.

Loc. Bay of Naples, Sorrento.

Descr. The oval body is characterized by its strong depression; the cuticle, which covers the whole body, is very firm, and in the dorsal part it forms at the surface four longitudinal elevations, four ribs, slightly spirally curved. The mouth, which is widely open in the form of a vertical fissure, is very visible on the ventral surface, from which originate two flagella, one of which, trained along behind, attains two and a half times the length of the body.

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* Fraipont, *l. c.* p. 92.

This species, which I have met with only once, at Sorrento, among the seaweeds on the shore, is very well characterized by its flat form, and especially by its four dorsal costæ, characters which prevent its being confounded with the other known species.

Urceolus Alenizini, Mereschk. 1877.

(Pl. XII. fig. 13.)

In my Russian memoir, already mentioned, on the Protozoa of the north of Russia, which appeared in 1877*, I described a new genus of Infusoria belonging to the order Flagellata, which I called *Urceolus*, and met with in the White Sea. A year later, in 1878, appeared M. Stein's book on the Flagellata, under the title of 'Der Organismus der Infusionsthiere,' Abth. iii., in which he figures (pl. xxiii. figs. 42–48) an organism which he describes in the explanation of the plates as a new form, giving it the generic name of *Phialonema*. On comparing the *Phialonema cyclostoma*, Stein, with my *Urceolus Alenizini*, I saw in a moment that the former was only a new species belonging to my genus *Urceolus*, established in 1877.

The genus *Urceolus* is characterized by the presence of a neck of greater or less length, with a wide aperture at its extremity, leading into a rather deep conical canal, at the bottom of which is situated the buccal orifice; it is also at the bottom of this canal, *a little to one side*, that the single flagellum originates. The genus has two species:—

1. *Urceolus Alenizini*, Mereschk. 1877.—Surface of the body smooth, without striæ; neck cylindrical, with the margins abruptly truncated and not turned out. *Loc.* White

2. *Urceolus cyclostomus* (Stein), Mereschk. 1878.—Surface of the body furnished with spiral striæ; neck obliquely truncated, and with the margin turned out. *Loc.* ——?

It is not right to regard, as I formerly did†, the aperture at the extremity of the neck, and through which the flagellum issues, as the buccal aperture, this latter being placed much more in the interior of the animal, at the bottom of the conical fossa situated in the interior of the neck.

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* In the Travaux de la Soc. des Naturalistes de St. Pétersb. vol. viii.

† C. Mereschkowski, "Studien über Protozoen des nördlichen Russlands," Archiv für mikr. Anat. Bd. xvi. 1879, p. 188.

XIX.—*On Synaxes, a new Genus of Crustacea.*

By C. SPENCE BATE, F.R.S. &c.

[Plate XIV.]

Genus SYNAXES*.

Carapace anteriorly produced between the eyes to a flat-pointed rostrum. Eyes lodged in distinct orbits. First pair of antennæ situated beneath the second, slender, terminating in two short flagolla; second situated outside and above the first pair, and terminating in a long and rigid flagellum, having the first two joints of the peduncle fused with the cephalon, and only three joints free. Pereiopoda monodactyle, first pair largest, posterior pair smallest, not chelate in the female. Branchiæ are trichobranchiate, having the podobranchial plumes attached to long mastibranchial plates (flabella). Pleopoda attached to the first somite of the pleon small and single-branched; those attached to the others are biramose, having the inner branch three-jointed and cylindrical, the outer foliaceous. The *rhipidura* (tail-fan) is broad and foliaceous, anterior portion of each plate calcareous, the posterior part membranous.

Synaxes hybridica.

The carapace is slightly depressed. The anterior margin is produced to a rostral point in the dorsal median line, and on the outer side of the eyes to nearly as far as the rostral point, forming a decided orbit in which the eyes are situated.

The pleon is as broad as the carapace; and small alæ on the first somite laterally protrude and overlap the posterior margin of the carapace laterally.

A slight but continuous line of elevation or carina traverses the median line of the second and three following somites, but is wanting on the first and sixth. The coxal plates are perfectly fused with their respective somites, and the *rhipidura* is foliaceous and well developed.

The eyes are small, placed on short peduncles, and distant.

The first pair of antennæ have the peduncle long and the flagella short; the second pair of antennæ have only three free joints to the peduncle, and no *scaphocerite* (or free scale), the two basal joints being closely fused with the *metopus* (or face); and the *phymacerite* (or tubercular opening to the green gland) is situated laterally, at the side of and close to the oral aperture.

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* σύναξις, combination.

The mandible is strong, and carries a small two-jointed *synaphipod* (or appendage).

All the pereiopoda are simple, terminating in short dactyli. The first pair is the largest, and is tolerably robust; the following gradually decrease in succession until the last, which is more than proportionally smaller than the preceding. The first pair of pleopoda is small and single-branched; all the others are biramose. The four following slightly diminish in size, the inner branch being biarticulate and slender, the other being uniarticulate and foliaceous. The sixth or posterior pair, which forms the outer plates of the rhipidura (tail-fan), consists of a short basal joint and two foliaceous branches; and the telson is broad and foliaceous, having more than half its length membranous and flexible. Length about 3 inches.

Hab. West Indies.

The carapace is about half the length of the animal. It is subcylindrical, being dorsally slightly flattened, so that an angular ridge traverses the sides from the anterior extremity of the outer angle of the orbit to the posterior margin of the carapace. The anterior margin is projected, between the eyes to an acute angle, and outside the same organs to about half the length of the central rostral projection, between which the orbit exists as a deep and more than semicircular excavation, the limits of which are defined by a small inner and outer protuberance. The margin of the orbit is fringed with an even row of small bead-like tubercles, which at the centre is divided by a small crevice or notch. The posterior margin is dorsally excavated, being posteriorly produced at the sides and depressed especially laterally, and is edged with a fringe of short hairs, and separated from the rest of the carapace by an even line or fissure.

The carapace has the surface evenly covered with small granular projections, a prominent few of which form a longitudinal line, commencing at the anterior point of the frontal margin between the eyes and terminating near the centre of the stomachal region. Those on the dorsal surface, when closely examined, are connected on the anterior side with three or four small punctures, through which small hairs are presumed to pass, from the circumstance of their being seen to remain on the anterior and lateral portions.

The pleon is similarly punctated, but more sparingly; and all the punctures point posteriorly.

The first somite is scarcely as broad as the carapace, and has on each side a small anteriorly directed aliform process that overlaps the posterior margin and retains the carapace in its position.

The second somite dorsally underlies and laterally overlies the first somite with a small flat projecting process, at the base of the upper part of which is the articulation on which the somite moves. In the central dorsal line is a narrow elevation or ridge, which is low and smooth and repeated on the three following somites. Laterally the coxal plates are fused with the somite very perfectly; and each successive somite articulates with the preceding by a small cup-like process, which receives the extremity of a small rounded tubercle that is situated in a notch in the posterior margin of the preceding somite.

The sixth somite is smaller than the others, and dorsally smooth, and supports laterally and posteriorly an appendage with two foliaceous branches.

The telson is anteriorly calcareous, and posteriorly foliaceous.

The eyes are small, and appended to the extremity of short peduncles that are laterally connected with the ophthalmic nerve through a long narrow foramen formed by the under surface of the rostral projection impinging against the upper surface of the first and second joints of the second antennæ, which is produced so far inwards and outwards as to meet on each side in a sharp process near the median line, close under the apex of the rostral projection.

The first pair of antennæ, in consequence of the formation of the basal joint of the second pair, is forced downwards, and, when viewed in a lateral or frontal direction the first pair of antennæ, is seen beneath the second pair. It is three-jointed and slender; the first joint is long and slight, the second and third are subequal and about half the length of the first, terminating in two small flagella that are not longer than the third joint.

The second pair of antennæ has the first and second joints solidly fused with the metopus (face) or ventral surface of the cephalon, so that three joints only are free. The basal joints are so closely fused together that it is impossible to determine their limits, beyond the fact of the position of the *phymacerite*. The third joint is broad and excavated on the inner and lower side to allow space for the first pair of antennæ, which the second pair partially overrides. The fourth or penultimate joint is broad and short; and the ultimate is about the same length, and with a short obtuse spine on the outer distal angle. This last carries a stiff and strong multiarticulate flagellum, each articulus of which is fringed with small bristle-like hairs.

The mandible is robust, smooth on the incisive margin, excepting for a single notch on one side and a corresponding tooth on the opposite, and furnished with a three-jointed *synaphipod*, the terminal joint of which is covered with numerous hairs.

The posterior oral appendages, as far as I am enabled to determine them without injury to the unique and dried specimen at my disposal, appear to approximate those of *Palinurus* in the possession of multiarticulate terminations to the outer branches.

The gnathopoda are flat and broad; the first pair has the dactylus absent, and generally resembles that of *Palinurus*. The second has the three terminal joints much narrower than the preceding, the margins of which are thickly furred with hairs.

The first pair of pereiopoda is stout and strong, the meros being the widest joint of the whole; the dactylus sharp-pointed, unguiculate and slightly curved; the propodos is stout and slightly narrower at the dactyloid than at the carpal extremity. The carpus is triangular and slightly shorter than the propodos; the meros is broad and long; the ischium and basis are short, fused into one triangular joint; and the coxa is strong and short. The three succeeding pairs of pereiopoda are more slender, but formed on the same type as the preceding, each successively decreasing in proportion; and the posterior pair is still smaller and more than proportionally slenderer than the others.

The first pair of pleopoda is subcentrally attached to the somite, and consists of a small, slender, unbranched appendage. The second and three following pairs are attached to the inner wall of the coxal plate and are biramose, the inner branch being two-jointed, slender, and cylindrical; the outer is single and foliaceous. The posterior pairs gradually decrease in size. The sixth pair of pleopoda is biramose and foliaceous, the anterior portion being hard and calcareous, terminating in small sharp teeth on the outer margin and central ridge, posterior to which the membranous portion is longitudinally ribbed and flexile.

The telson is broad at the base and rounded at the extremity; the anterior division is calcareous, and armed with two minute points equilaterally distant from the margins and centre, but the posterior division is membranous and flexile.

It has been to me a matter of curious interest to observe how in the history of classification every zoologist of note has, previously to the anatomy and development of the separate genera being well understood, associated the two very dissimilar looking animals of *Ibaccus* and *Palinurus* in one family.

It must have been based almost, if not absolutely, on the uniformly simple character of the pereiopoda, or walking-feet, although Milne-Edwards supported it by the character of the branchial appendages; but the condition of depression that he assigns to the *Macroures cuirassés* is scarcely in accordance with the cylindrical form of *Palinurus*. But this advanced carcinologist has separated them into distinct tribes (subfamilies), based on the very distinct form of their antennæ; while Leach classed them in one family, which corresponds with *Macroures cuirassés* of Edwards, except that he included the genus *Porcellana* as well as *Galathea*; while Edwards includes *Galathea* and the Eryonidæ, which latter family was not known to Leach, and only to Edwards in a fossil condition.

The union of these very distinct generic forms, in some parts so wholly unlike, clearly demonstrates that the conclusions that have been arrived at were based on a hypothetical rather than on a clear appreciation of the structure and development of the several genera.

If we take the carapace of the two forms and place them side by side, without any of the appendages attached, we shall at once see how very distinct that of *Ibaccus* and all the Scyllaridæ is from that of the Palinuridæ, even when we take them from *Arctus*, the nearest approximating genus of the two families.

In the Scyllaridæ the eyes are implanted in two distinct and perfect orbits that are almost complete in their circular circumference; and these are situated far apart, in some genera (as *Scyllarus*) as far as the limits of the carapace will admit.

In the Palinuridæ there is no orbit, and the peduncular structure, whether calcareous, as in *Palinurus*, or membranous, as in *Panulirus*, lies in front of the anterior margin of the carapace, and the eye-peduncles are connected with each other at their base.

The dorsal surface of the first antennal somite in *Ibaccus* and all the Scyllaridæ is projected in front, and locked by a pair of dovetailed processes into the anterior margin of the carapace; and the first pair of antennæ is articulated at the anterior margin of this somite.

In the Palinuridæ the first antennal somite does not appear in connexion with the anterior margin of the carapace, but is developed as a large and conspicuous structure in advance of the eyes, and at its anterior extremity the first pair of antennæ is articulated.

The second pair of antennæ resemble each other in the two separate families in their connexion with the body of the animal. The first joints are completely fused together and with the somites to which they are attached; and there is nothing to distinguish them from the metopus or frontal surface of the anterior somites, except the presence of the phymacerite, or tubercular opening to the green gland. Three are all that are apparent as freely articulating joints belonging to the peduncle of this pair of antennæ. The terminal joint that in the Scyllaridæ exists as a broad, flat, and scale-like plate, homologizes with the long multiarticulate flagellum of the same antennæ in Palinuridæ.

The oral organs in the separate families are very distinct; but the individuality lessens in the appendages as they recede from the mouth. The gnathopoda are in several of the genera only specifically distinct. The pereiopoda or walking-legs are typically the same even to the development of a small chela at the extremity of the last pair in the females.

The carapace is bolted down by a strong tubercle attached to the sides of the last somite of the pereion (*pereiocleis*[*]), both in the Palinuridæ and the Scyllaridæ; and in each there is a small aliform process that overlaps the posterior margin of the carapace (*pleocleis*[†]) attached to the first somite of the pleon, but which is less important in the Palinuridæ than in the Scyllaridæ. All the somites of the pleon, inclusive of the telson, are generically alike; but the pleopoda or appendages vary.

In the Palinuridæ the first pair is absent, and all the others, except that which goes to form the tail-fan, consist of a single round and foliaceous plate in the male, whereas in the female the second pair (Plate XIV. fig. 6, *q*) has two foliaceous, ovate, disk-like plates, the inner being attached to a two-jointed pedicle; the third pair (*r*) consists of an inner three-jointed biramose branch, and an outer, ovate, foliaceous plate; the two following are on the type of the third pair. In the Scyllaridæ the first is present in both male and female, and is biramose, but foliaceous in the female and styliform in the male (fig. 5, *p*). The four succeeding are biramose, one branch being cylindrical and three-jointed, the other single-jointed and foliaceous, being varied a little in both sexes; but the whole are distinguishable from those of the Palinuridæ.

The species which I have just described under the name of *Synaxes hybridica* appears to be a combination of the two families—an intermediate form that connects the two very dissimilar groups, and shows the way in which they approximate the more normal types of the Macrura.

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[*] κλεὶς, bolt, and *pereion*.

[†] κλεὶς, bolt, and *pleon*.

The eyes are those of the Scyllaridæ; the second pair of antennæ are those of the Palinuridæ. The legs are common to both forms, and the carapace belongs to neither. The frontal region resembles neither; and the posterior resembles both, as also does the pleon, whereas the pleopoda are modelled on the type of those of the Scyllaridæ, and the tail-fan is that of both.

The first thing that strikes the observation is the rostriform advancement of the frontal margin, as being very different from that of either *Scyllarus* or *Palinurus*. In *Panulirus* the frontal margin in the median line does not advance beyond that of the eyes; but in *Palinurus marinus* there is a small triangular prominence that projects above the ophthalmic somite in the median line. In *Palinurus Lalandii* this prominence is still further produced, and is so far advanced that it reaches beyond the ophthalmic somite, which it covers, and, dipping down, meets the inner portion of the ventral surface of the third somite, and so forms an imperfect orbit *. In *Synaxes* the rostral prominence is so far advanced that it reaches to the extremity of the third or first free joint of the second pair of antennæ, beneath which the anterior and inner angle of the second joint of the second pair of antennæ is visible, and is seen to articulate with the inner and posterior angle of the next joint.

Laterally, on the outside of the orbit, the frontal margin is produced considerably in advance of the line of the organs of vision, and is longitudinally folded at an obtuse angle beneath the ventral surface. This antero-lateral development of the carapace (which I do not remember to exist anywhere so prominently, except in *Polycheles* and its generic allies) produces in the frontal margin of the carapace an orbit that is almost as deep as that of *Scyllarus*. The posterior margin of the carapace is not free as in the Astacidæ, but firmly secured in its position by an osseous tubercle (*pereiocleis*) attached to the last somite of the pereion, and lodged in a corresponding closely-fitting hollow on the underside of the carapace, so that it cannot be raised as we see that some Crustacea have the power of doing. The anterior somite of the pleon overlaps laterally, by means of small wing-like processes (*pleocleis*), the posterior margin of the carapace. This is a feature strongly pronounced in the Scyllaridæ and in *Polycheles* and its allies; it also exists to some extent in the Palinuridæ, but to a less efficient degree.

The ventral surface of the pereion in our female specimen is broad and flat; and all the legs have the second and third joints fused into one—a feature common to the Palinuridæ and Scyllaridæ, but not to be found in any other form of the Macrura.

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* I am much inclined to think that *P. Lalandii* of Edwards must generically be separated from both *Panulirus* and *Palinurus*.

The last or fifth pair of pereiopoda is very much smaller than either of the preceding pairs; but it terminates in a simple dactylus, whereas in the Scyllaridæ and the Palinuridæ, and in some of the genera allied to *Polycheles*, the female has the posterior pair terminating in a minute chela—a feature that is common to the Anomurous Crustacea, but not to be found in the Astacidæ or Homaridæ, and separates them from those that possess this character.

In *Synaxes* the pleon has a longitudinal central ridge or line of elevation—a feature common to many of the Scyllaridæ, but seldom seen in the Palinuridæ, although lines of demarcation without elevation are apparent in the *Palinurus marinus* of our seas. It becomes a prominent feature in the Eryonidæ, but is never seen in the Astacidæ or Homaridæ.

The pleopoda are developed very similarly to those which exist in the Scyllaridæ, and are distinguishable from those of any other form among the Macrura, especially in the female, where one, the inner (or true representative of the leg), is three-jointed and cylindrical, and the outer is a simple foliaceous plate. In the Palinuridæ in the male there is only the outer leaf-like plate, the inner ramus being absent. In the females the second pair consists of two foliaceous plates, the third and following of one foliaceous plate and a subcylindrical biramose branch. The appendage which belongs to the anterior somite is well developed in the Scyllaridæ, is reduced to a small cylindrical rod in *Synaxes*, and is absent in the Palinuridæ.

The position among the Macrura that the present species occupies is very near to *Palinurus*; and its departure appears to approximate more or less closely the genera that go to make up the family of the Scyllaridæ. The first distinguishing feature is the advanced rostriform projection between the eyes, of which we have no representative in either of the known families, although in some species a small incipient process appears to exist, as in *Palinurus marinus*. But this feature in *Synaxes* brings the form of the carapace into close resemblance with that of the Astacidea, from which it may be distinguished by its being secured at the posterior margin. The breadth of the ventral surface of the pereion, the form of the pereiopoda and antennæ are all peculiar to the Palinuridæ, whereas those of the pereiopoda and the pleopoda are essentially features of the Scyllaridæ. It would thus appear that the specimen assumes a hybrid appearance. All the anterior appendages except the eyes are those of *Palinurus*; the eyes and the posterior appendages are those of *Scyllarus*, while the intermediate appendages are common to both. It does not belong to any genus of the Palinuridæ; and it does not belong to any in Scyllaridæ: it either unites the two outlying families into one, or it is the type of a form distinct from either. My own inclination is to bring the three into one family; but our want of knowledge of the character of the brephalus of *Synaxes*, whether it be that of *Phyllosoma*, as are those of the other two forms, in each of which are several very distinct and well-defined genera, makes it more prudent for the present to group it in a distinct subfamily in the same tribe as the other two, thus:—

SYNAXIDEA.

Synaxidæ.

Scyllarina. *Synaxina.* *Palinurina.*

The dried condition of the specimen at my disposal has enabled me only slightly to examine the branchial apparatus; but from what I have seen I think it may be tabulated by the same formula as that of *Palinurus* and *Scyllarus*.

The specimen has been kindly lent to me for examination by Dr. Carte, and belongs to the Natural-History Museum under his care in Dublin. It was taken in the West Indies by Commodore Sir F. M'Clintock; but the depth and precise locality are not recorded.

EXPLANATION OF PLATE XIV.

Fig. 1. *Synaxes hybridica.* Dorsal aspect.
Fig. 2. *S. hybridica.* Ventral aspect.
Fig. 3. *S. hybridica.* Lateral aspect of cephalon (eye removed).
Fig. 4. *q*, second pair of pleopoda (*Synaxes*, female).
Fig. 5. *p*, first pair of pleopoda (*Arctus*, male); *q*, second pair of pleopoda (*Arctus*, female); *r*, third pair of pleopoda (*Arctus*, female).
Fig. 6. *q*, second pair of pleopoda (*Palinurus*, female); *r*, third pair of pleopoda (*Palinurus*, female).

XX.—*On the first Part of a Memoir by Mons. Charles Oberthür on the Lepidoptera of the Isle of Askold.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

IN the last livraison of his 'Etudes d'Entomologie' (some preliminary diagnoses for which were kindly forwarded to me by the author late in 1880) M. Oberthür gives an account of a collection of Lepidoptera received by him from the Isle of Askold, Mantchooria.

Whilst lepidopterists are much indebted to M. Oberthür for the numerous careful figures which illustrate this memoir, it must be a cause for regret to all who study it that equal care has not been taken to avoid the multiplication of synonyms.

Monsieur Oberthür is, I feel sure, too genuine a naturalist to be hurt at the correction of any errors which may have crept into his publications; and as the Lepidoptera of China and Japan have, for years past, been my special study, I feel called upon, in the interests of science, to review a paper bearing so intimate a relation as this does to the entomological resources of those countries.

It seems to me that when an entomologist is ready not merely to distinguish every geographical race as a species, but to give a distinct name to every admitted variety or sport, he ought, for the sake of consistency, if for no better reason, to adopt all genera founded upon well-defined structural characters. This, however, M. Oberthür has not done, as will be at once seen by the following revised list of his supposed new species.

The advantage of numerous genera is (it seems to me) to enable a naturalist who does not possess in a large measure the gift of order which would enable him to group allied forms by their external facies, to associate them by the more scientific mode of examining and comparing their structural peculiarities.

The following is a list of the Heterocera in M. Oberthür's memoir, with corrections of their specific and generic names where required:—

Sphingidæ.

Smerinthus askoldensis, Oberth. Belongs to the group of genera near *Proserpinus*, although in some of its characters it more nearly resembles *Pergesa*. It has no connexion whatever with the Smerinthinæ.

Smerinthus Jankowskii, Oberth. Near to *Triptogon dyras* from Ceylon.

Sphinx Davidis, Oberth. A species of the genus *Hyloicus*.

The three species of Sphingidæ will therefore all stand, although in different genera from those to which they are referred.

Zygænidæ.

Procris psychina, Oberth.

Lithosiidæ.

Lithosia gigantea, Oberth. Referable to the genus *Collita* of Moore.

Calligenia askoldensis, Oberth. Near to *Miltochrista miniata*, if distinct.

Arctiidæ.

Spilosoma Dœrriesii, Oberth. = *S. punctarium*, Cram.

Spilosoma Jankowskii, Oberth. Near to *Spilarctia lacteata* of India.

Of *S. seriato-punctata*, Motsch., which he figures under the name of *S. striatopunctata*, M. Oberthür describes specimens as having more or less rose-colour over the secondaries. As we have both sexes with barely a trace of rose-colour both from Yokohama and Tokei, I strongly suspect that these examples with rose-coloured secondaries are referable to my *Spilarctia rosacea*. The basal black costal dash is characteristic of a group of allied species; but its existence on opposite sexes of two otherwise dissimilar forms is very apt to mislead collectors, who naturally jump to the conclusion that they have discovered the male and female of one species.

Liparidæ.

Dasychira virginea, Oberth.

Dasychira olga, Oberth.

Dasychira acronycta, Oberth. Two species are here confounded, the male being that sex of *D. lunulata*, Butl.; the female, which is new, may retain the name. We have both of these species from Japan in both sexes; and a mere glance at the two males or females side by side would convince the most prejudiced of their entire distinctness: the male of *D. acronycta* is considerably smaller than the female; and the female of *D. lunulata* is in like manner considerably larger than its own male.

Leucoma piperita, Oberth. A species of *Artaxa*, which we have recently received from Tokei, Japan.

Lasiocampidæ.

Pyrosis eximia, Oberth. Near to *Podalia dorsimacula*, Wa

Odonestis askoldensis, Oberth. Described as a dark variety of *O. potatoria*; but the latter species varies to any extent in this respect; the colouring, however, appears to resemble that of *O. albomaculata*, a common Japanese species which certainly is (as M. Oberthür suggests) distinct from *O. potatoria*.

Odonestis unicolor, Oberth. Described as a red variation of *O. excellens*, Butl.

Trisula andræas, Oberth. = *Phalera flavescens*, Bremer. This species is a Notodont, although referred by M. Oberthür to the Lasiocampidæ, next to what he calls "*Bombyx!*" *neustria*; the genus *Trisula*, on the other hand, is a broad-winged Liparid having the larva of a *Lymantria*. *P. flavescens* is a common Japanese species.

Saturnia Jankowskii, Oberth. Referable to the genus *Rhodia*.

Euphranor cæca, Oberth. A form quite new to me.

Pseudopsyche Dembowskii, Oberth. A species of *Panisa* near *circumdata*.

Limacodidæ.

Limacodes castaneus, Oberth. = *Phrixolepia sericea*, Butl. M. Oberthür admits this synonym in the note at the end of his description; but he nevertheless retains his own name.

Limacodes dentatus, Oberth.

GEOMETRITES.

Nyssiodes olgaria, Oberth. According to Dr. Staudinger (so M. Oberthür tells us), this is probably the *Biston lefuarius* of Erschoff. If this is so, surely it is unwise to run the risk of adding to the synonymy by proposing another name for it. We have this species from Yokohama, sent by Mr. Pryer.

Boarmia stipitaria, Oberth. Very near to *B. consortaria*.

Boarmia piperitaria, Oberth.

Boarmia Dembowskiaria, Oberth. This species, in my opinion, does not belong to the Boarmiidæ; the character of its markings is rather that of *Fidonia*. It could in no case be referred to *Boarmia*, if its antennæ are so slender as represented. The *B. mandshuraria* of Bremer appears to me to be a *Melanippe* allied to my *B. abraxaria*.

Boarmia amphidasyaria, Oberth. This is a *Hemerophila*.

Phorodesma Jankowskiaria, Mill.

Phorodesma amœnaria, Oberth. This is a *Comibæna*.

Nemoria amphitritaria, Oberth. This is a *Thalera*.

Acidalia unio, Oberth. Is not this a *Corycia*?

Phasiane griseo-limbata, Oberth. = *Nematocampa straminea*, Butl.

According to M. Oberthür his "Diagnoses" were published in August 1879, and consequently take priority of my paper published in the 'Annals' for November and December 1879.

Rhyparia askoldinaria, Oberth. Since it is not advisable to use the same generic name twice over in different groups of the Heterocerous Lepidoptera, I proposed the name *Icterodes* for this genus (see Ill. Typ. Lep. Het. ii. Index, p. ix, and pl. xxxvii. fig. 9), a fact which M. Oberthür seems entirely to have overlooked.

Melanippe luctuosaria, Oberth.

Anticlea Taczanowskiaria, Oberth. Common at Tokei, Japan.

M. Oberthür refers my *Acidalia unisterpis* to *Camptogramma*, by which alteration he certainly does not improve matters. The species is somewhat variable, and is doubtless identical with Moore's *A. plurilinearia*; it certainly is allied to *A. moniliata*, and is neither allied to, nor does it in the least resemble, any species of *Camptogramma*.

Eucosmia Hedemannaria, Oberth. = *Scotosia certata* of Europe, which we have also from Japan. M. Oberthür says that the common transverse line is noticeably more undulated; this, however, is an individual difference existing only between the single example in M. Oberthür's possession and his specimens of *S. certata*.

Cidaria corussaria, Oberth. = probably *C. russata*, var., of Europe. There are few species more variable than this, one of the least extraordinary of its modifications being the entire absence of lines or bands from the secondaries. We have specimens very similar to that figured by M. Oberthür both from Japan and North America.

Cidaria venulata, Oberth. Near to *C. umbrosaria* and *C. relata*.

Cidaria fabrefactaria, Oberth. = *C. corylata* of Europe.

Cidaria askoldaria, Oberth. = *C. jameza*, Butl., ♀.

Of this species we have hitherto only received one male, and M. Oberthür one female; the differences between the two are only precisely what exist between the sexes of other species.

Cidaria ludovicaria, Oberth.

It is a pity that M. Oberthür did not form a new genus for this species, for *Abraxas junctilineata*, *A. plurilineata*, &c.; they are not true Zerenidæ, yet look quite out of place in *Cidaria*, from which they differ in their shorter palpi, somewhat different venation, and utterly dissimilar coloration. M. Oberthür, however, seems to consider it a hindrance to study to group allied forms together under distinctive names: if this be not the case, it is incomprehensible why he should almost invariably refer his new species to the magazine genera of the older authors.

Cidaria achatinellaria, Oberth. = *C. achatinaria*, var. According to the author this only differs from the European species in its better-defined markings and redder colouring—differences such as occur between individuals of the same species in most genera of Lepidoptera.

Notodontidæ.

Dicranura askolda, Oberth. =*D. felina*, Butl.

It is strange that, in this instance, M. Oberthür has not even referred to my species; his figure agrees exactly with some specimens from Japan, differing from my *type* only in its paler colouring, due, I have no doubt, partly to starving in the larval condition, and partly to rubbing. The species frequently attains a much greater size.

Harpyia Taczanowskii, Oberth. Probably a *Thiacidas*, but most certainly not a *Harpyia* (compare with *H. verbasci* of Europe).

Uropus Branickii, Oberth. A *Phalera* of the *P. sigmata* group.

Notodonta lineata, Oberth.

We have a specimen of this species from Tokei, Japan.

Notodonta Jankowskii, Oberth. Very close to *Peridea dromedarius*.

Notodonta Dembowskii, Oberth. Apparently another *Peridea*.

Notodonta monetaria, Oberth. A *Peridea* close to *P. trepida*.

Notodonta bombycina, Oberth. This species does not appear to me to belong to the Notodontidæ; it may be a Limacodid, a Lasiocampid, or possibly even a Liparid. Without seeing the insect I could not positively refer it to its true family; but its aspect is less that of a Notodontid than of any of the others. In pattern it is more like many of the Noctuites.

Drymonia biloba, Oberth. Seems allied to *Colocasia coryli*, Linn.

Drymonia velutina, Oberth. Appears to be an *Ochrostigma*.

Drymonia lichen, Oberth. Referable to Walker's genus *Cascera*.

Notodonta plebeia, Oberth.

Trabala splendida, Oberth. Congeneric with *Nadata*.

I am responsible for this generic error, having been misled by Walker's careless assignment of *N. niveiceps* to his genus *Trabala*. A reference to Abbot's 'Insects of Georgia,' ii. pl. lxxxii., will convince M. Oberthür that the proper location for *N. splendida*, *cristata*, and *niveiceps* is with *Nadata gibbosa*. The convergence or divergence of the lines on the primaries seems to be an inconstant character in this group.

Ptilodontis plusiotis, Oberth. Not a *Ptilodontis* (=*Pterostoma*).

This species has the aspect of *Celeia*, a genus near to *Spatalia*; but M. Oberthür figures it with filiform antennæ, a most abnormal character for a male Notodont. Surely this is an artist's error?

Lophopteryx Ladislai, Oberth.

NOCTUITES.

Cymatophora argenteopicta, Oberth. Near to *C. plumbea*, Butl.

Cymatophora ampliata, Oberth. (nec Butl.). = *C. or* var. of Europe?

M. Oberthür's criticism of the lithographic drawing of this species, being based upon the supposition that he possessed my species, falls to the ground. The species recognized by Walker as *C. ocularis*, Linn., but by Dr. Staudinger as *C. octogesima*, seems to me to be referable to *Asphalia*, not to *Cymatophora*; nevertheless it will perhaps be best to give the name of *C. intensa* to the Japanese species of this name, and thus save all confusion.

Dichonia goliath, Oberth. Apparently an *Agriopis*, in which case it should be placed in the Arctiidæ near to *Diphtera*. The type of *Moma*, Hübn. (a genus of Notodontidæ) is *M. ludifica*, not *orion*.

Leptina macroptera, Oberth. = *Cyana decipiens*, Butl.

It seems that my specific name was well chosen, since M. Oberthür has been deceived by the mere pattern of the primaries into placing it with the North-American Noctuites of the genus *Leptina*. It is a true Lithosiid, and agrees in all its structural characters with *C. detrita*.

Apatela Jankowskii, Oberth.

M. Oberthür says that the nearest European species to this is *Apatela strigosa*; but as *strigosa* is the type of *Hyboma*, it follows that, if allied, *A. Jankowskii* cannot be an *Apatela*. It is more like *Leptina*.

Leucania inanis, Oberth.

Rhizogramma aurilegula, Oberth.

I think it doubtful whether *E. petrorhiza* can be separated generically from *Eucalimia* (*E. gnaphalii*); but if so, it might be placed with my *E. saga* of Japan, to which M. Oberthür's species seems also to be allied. I find that *L. petrificata* (type of *Lithophane*) differs generically from *E. saga*, which I provisionally referred to the same genus.

Apamea askoldis, Oberth. Like *A. ophiogramma* in pattern.

Miana arcta, Oberth. (nec Lederer). =*Raphia fasciata*, var. ?

Lederer's species is a true *Miana*, so far as I can judge by his figure.

Miana parietum, Oberth. Probably =*Raphia fasciata*, Butl.

This figure by M. Oberthür does not represent the white fringes to the tegulæ and whitish metathorax of *R. fasciata*; but it does not appear to be very exact, the markings seem blurred.

Caradrina albosignata, Oberth. =*Radinacra*, sp. close to *R. lineosa*, Moore.

We have Moore's species from Tokei, which renders the distinctness of *C. albosignata* a little doubtful; still, if the slight differences noticeable in M. Oberthür's figure are true to nature, the species will stand.

Caradrina cæca, Oberth. Described as a variety of the preceding. We have a specimen of this moth from Tokei.

Agrotis autumnalis, Oberth.

Noctua stupens, Oberth. = *Ochropleura* near *O. musiva* of Europe.

We have this species from Tokei; it is of little more than half the bulk of *O. stupenda*; the name given is so near to mine in sound that it is a pity it was used.

Noctua hysgina, Oberth. = *Graphiphora lubentia*, Butl.

Tæniocampa aurariæ, Oberth. =*Semiophora*, sp.

Dianthæcia admiranda, Oberth. Near to *Epia echii* of Europe.

Phlogophora pallens, Oberth. =*Phlogophora periculosa* ?, Guén. (faded).

M. Oberthür says that this is without doubt the species which I figured under the name of *P. beatrix*. If M. Oberthür had no doubt about this, why did he (knowing my description was published probably before his specimens were caught) take the trouble to rename it. If M. Oberthür's figure is a good one, *P. pallens* is, without doubt, not my *P. beatrix*; it is smaller, of a different shape, altogether paler and duller, and the belt across the primaries is of a very different form. It agrees exactly with a pale specimen of *P. periculosa* in our collection; and this I believe it to be.

Aplecta askolda, Oberth. Described as a variety of *Eurois nebulosa*.

E. imbrifera differs from *E. nebulosa* much in the same way.

Hadena Jankowskii, Oberth. =*Apamea gemina*, var., Hübn.

Nobody who knows the extreme variability of this species can regard M. Oberthür's form as a distinct species; we have European examples rather larger than his figure and agreeing with it in pattern.

Hadena kosakka, Oberth. Near to *H. atriplicis*, but with the white spot of the primaries formed as in *H. auriplena* (*Eurois? auriplena*, Wlk.).

Telesilla malachites, Oberth. =*Canna*, sp. close to *C. pulchripicta*.

Acontia variegata, Oberth. Apparently an *Anarta* (*A. myrtilli* group.)

Acontia flavomaculata, Oberth. Somewhat like "*Erastria*" *rubicunda*, Wlk., but probably congeneric with the preceding species.

Erastria nemorum, Oberth. Near to *E. fuscula*, which is common in Japan.

Erastria costimacula, Oberth.

Erastria mandschuriana, Oberth. Belongs to the Limacodidæ.

We have this beautiful little moth from Tokei; its coloration and the slenderness of its abdomen must have been the only characters which suggested to M. Oberthür that it belonged to the Acontiidæ; its short, curled, pectinated antennæ (misrepresented by M. Oberthür's artist), and the scattered shining scales all over the primaries, as also the banding of these wings beyond the middle, should have guided him to the natural family of the species. I would propose to call this genus *Mimerastria*, from the somewhat vague resemblance which the species bears to *E. candidula*, and which has thus misled M. Oberthür.

Plusia nadeja, Oberth. =*Plusia zosima*, var., Hübn.

In the British Museum from Japan; it attains a considerably greater size than the figure, which is very poor: the discal line and outer border of the secondaries are wholly omitted by the artist; and the brown patches on the primaries are too pale. If the Japanese form be regarded by M. Oberthür as distinct (as possibly it may be), I will not deprive him of the pleasure of naming it.

Plusia esmeralda, Oberth. =*Plusia moneta*, var., Linn. (teste M. Oberthür).

Plusia locuples, Oberth. =*Plusia ornatissima*, Walker.

This *Plusia* is fairly common in Japan.

Amphipyra obscura, Oberth. =*Amphipyra pyramidea*, L. (teste Oberth.).

Catocala obscurata, Oberth. = *C. unicuba*, Walk.

I see that M. Oberthür has united the genera *Chrysorithrum* and *Bolina*! After this nothing will surprise me; for I do not think two genera of Noctuites less alike could easily be found.

Capnodes Jankowskii, Oberth.

Madopa flavomacula, Oberth.

Thus finishes M. Oberthür's first part of his Memoir on Lepidoptera of the Island of Askold. It is sincerely to be hoped that his next will be an improvement upon it, as it is impossible to overestimate the injury, through waste of time, which is occasioned to workers by the publication of duplicate names for the same species—a fault which, of all men, I had believed my friend M. Oberthür one of the most anxious to avoid.

XXI.—*Contribution to the Knowledge of the Family* Tintinnodea. By HERMANN FOL, Professor in the University of Geneva*.

[Plate XVII. figs. 1–6.]

THROUGHOUT the still imperfectly known class of the Infusoria there is perhaps no group of which the structure, classification, and synonymy are so obscure as those of the family of the *Tintinni*. This is because most authors have thrown pell-mell into this family very diverse forms, characterized so insufficiently that one does not know what to make of such problematical types. Or, again, we have seen authors who only knew a small number of forms belonging to a different group, take these forms as the type of the family, and, upon this erroneous basis, upset the diagnosis of the latter.

But, before seeking to establish the zoological position of our Infusoria, it will be well to cast a glance at the organization of the forms that I have observed, so as to be able to compare my results with those of other authors.

The Tintinnodea are very abundant in the roads of Villefranche, but all belong to a few species which I shall describe hereafter. These species, moreover, will be divided into three distinct genera, taking as the basis of the classification the form of the test. Nevertheless the structure of the animals presents a remarkable uniformity.

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* Translated by W. S. Dallas, F.L.S., from the 'Bibliothèque Universelle: Archives des Sciences Physiques et Naturelles,' 3e période, tome v. pp. 5–24, January 15, 1881. The writings of previous authors are referred to by numbers, which are explained in a bibliographical list at the end of the memoir.

The body (Pl. XVII. figs. 2 and 4) is, in general terms, conical, terminated above by a broad disk, and produced below into a contractile appendage which is longer or shorter according to the species. Energetic as are the contractions of this sort of peduncle, it nevertheless does not present that transverse striation, recalling the texture of the striped muscles, which characterizes the peduncle of the *Vorticellæ*. Claparède and Lachmann (VII. p. 195) have clearly recognized this fact, which helps to establish the distinction between the *Tintinni* and the *Vorticellæ*. Stein has observed that, when the animal detaches itself from its test, the peduncle enters into the body and becomes confounded with it—a proof that it consists of sarcode with no special differentiation.

The superior discoidal extremity or peristome, when the animal is in a state of perfect extension, is placed a little obliquely with relation to the aperture of the test. This position, and the long cilia which garnish it, give it a great resemblance to the disk of the *Vorticellæ*. Nevertheless this similitude is only apparent, as Claparède and Lachmann have well remarked. In fact, the mouth, instead of being placed at the outer margin of the disk, as in the *Vorticellæ*, is situated in its interior, and often even near its centre. The disk itself, instead of being flat or slightly convex, as is the case in the Vorticellina, is hollowed out like a saucer; and the vibratile cilia, instead of forming a single row round the margin of the disk, are implanted in great numbers and in several lines over the greater part of the surface.

The arrangement of these vibratile cilia is exceedingly curious and interesting, and deserves to fix our attention the more because it has not been described by any of the authors who have busied themselves with the *Tintinni*.

The whole margin of the disk is occupied by long and strong motor cilia, which strike the water vigorously and give the animal an exceedingly rapid rectilinear movement of translation. All authors speak of this unruly natation, and of the rapidity with which the animal traverses the field of the objective, and they make it an excuse for any thing that may be imperfect in their descriptions.

I have spoken of a rectilinear movement. It is thus, in fact, that the animals habitually swim; but they can readily deviate from the direct line when they have to avoid an obstacle. Moreover the animal is constantly turning upon itself during its progress, which is therefore comparable to that of a rifle-ball.

As soon as these great motor cilia commence their action, they present the so-called phenomenon of rotation in a high degree. The undulation is propagated from right to left, the observer being supposed to be placed in the axis of the animal; so that one would imagine he saw a toothed wheel turning in the direction indicated (Pl. XVII. figs. 2, 3, and 4). Are these cilia implanted upon a single circular or spiral line, as Stein supposes? or do they form a broken line? To solve this question we may begin by examining the arrangement of the other cilia which garnish the upper surface of the disk.

These cilia are arranged in parallel lines, all curved in the same direction (fig. 3) and running from the margin of the disk, or peristome, towards the mouth. In one species I have counted twenty-four of these rows. The mouth occupying an excentric position, the rows which start from the margin nearest to that aperture are of course much shorter than those which start from the more distant margin (see figs. 2 and 3); the others are of intermediate length. There are, however, only a few lines of cilia that actually reach the entrance of the mouth; and these are precisely the shortest ones. The others stop so as to leave the central part of the disk naked (fig. 3).

All the rows of which I have just been speaking are formed of thick, short, slightly recurved cilia, scarcely attenuated at their free extremity, and only beating for moments. Their length decreases regularly from the margin of the peristome, which bears the thickest and longest, to the inner extremity of the row, which is formed of much shorter and more slender cilia (see figs. 2 and 3). The shortest rows, which occupy the buccal margin, are also those the cilia of which are shortest on the average.

Let us now return to the motor cilia, to ascertain what relation they may present to the cilia of the disk. And, in the first place, if we carefully examine the margin of the peristome from the upper surface, leaving out of consideration the cilia with which it is furnished, we shall notice that this margin is not simply rounded, but rather denticulated. The teeth resemble those of an ordinary saw; that is to say, each tooth is bounded by two lines, one of which is very long and nearly a tangent to the circumference, while the other is short and nearly follows the direction of a radius. It is unnecessary to say that all the teeth are turned in the same direction. Now this direction is precisely that towards which the rows of short thick cilia deviate; and each of the rows corresponds to one of the denticulations of the margin, in such a manner that it terminates at the base of the longer side of the denticulation, or that which forms a tangent to the margin of the disk.

This arrangement once understood, it is easy to ascertain that the large motor cilia are implanted upon the longer margin of each denticulation. Hence they do not form a continuous circular or spiral line, but a broken line, the segments of which are only simple continuations of the rows of short cilia. In other words, all the cilia, whatever they may be, which garnish the disk are implanted in accordance with about twenty parallel spiral lines. Each row commences tangentially to the margin of the disk by a certain number of motor cilia, then curves towards the centre, bearing thick short cilia, gradually diminishing from the periphery towards the centre.

The entrance to the mouth meets the surface of the disk obliquely, the pharynx being directed towards the left, at the same time gradually contracting (figs. 2 and 3). By looking at the animal in profile (fig. 2) it is easy to see that the pharynx is lodged in a pouch-like lateral projection of the body of the Infusorian. This projection is more strongly marked in certain species, and becomes very striking in meagre individuals when placed exactly in profile (fig. 2). We then see that a certain number of the rows of cilia of the disk (those, no doubt, which start from the margin of the peristome nearest to the mouth) descend into the pharynx, and there form a series of nearly straight parallel lines composed of extremely fine cilia.

The actual margin of the mouth is furnished with tolerably stout and long cilia which beat energetically; but I have not succeeded in ascertaining precisely what relation may exist between these cilia and those which I have just described in detail. All the rest of the surface of the body of the species that I have observed was smooth; at least it is hardly probable that cilia, however fine they might be, could have escaped my observation had they actually existed.

The description that I have just given may seem long. This is because the difficulty of observation is extreme, because the eye must be aided by reasoning, in order to succeed in understanding an arrangement so complex and so novel in science, and because I determined to follow in my exposition the same order as in my researches, so as to facilitate the verification of my results.

Claparède and Lachmann (VII. p. 192) indicate as the general character of the Tintinnodea that these animals are ciliated on their whole periphery, and that the peristome bears vigorous cirri, forming several concentric rows. We have just seen that the general ciliary covering is deficient in many species, and that the cilia of the peristome present an arrangement very different from that indicated by the above authors.

Stein (who is above all preoccupied by the relationship which he supposes to exist between the *Tintinni* and the *Vorticellæ*) declares that the peristome bears cilia only at its margin—namely, a single row, which descends into the mouth, and in this way represents a dextrogyrous spiral. I am quite ready to believe that Stein had before him an Infusorian thus organized, since he tells us so; but this animal certainly was not a *Tintinnus*, and probably belonged to some group allied to the *Vorticellæ*. Another marine form, observed without test, but which this author rightly or wrongly regards as the legitimate proprietor of certain empty tests found in the produce of the same gathering—another form, I say, is described as bearing on the margin of the peristome an outer row of long cilia, and a single inner row of cilia only half the length. It is difficult to judge whether the author had to do with a *Tintinnus* of which he has given only an imperfect description, or with some quite different genus of Infusoria. In any case Stein's observations were less fortunate than those of Claparède and Lachmann, to whom the German writer addressed criticisms as severe as they are undeserved.

If we carefully examine the surface of the disk in the neighbourhood of the mouth, we observe there a slight crescentiform projection, which rises above the side on which the margin of the orifice forms an acute angle (see fig. 3). Are we to compare this projection, with its scarcely indicated outlines, to the part that Stein describes in his so-called *Tintinni* under the name of "forehead," and compares to the disk of the *Vorticellæ*? I cannot tell; but it is certain that the slight swelling in our *Tintinni* has no relation, near or distant, with the disk of the Vorticellina.

The nucleus of our *Tintinni* is very difficult to see. It can hardly be discerned except in famished individuals. Moreover I have not paid much attention to this organ, since it is at present demonstrated that the form, the structure, and the number of the cytoblasts varies infinitely more in the different periods of the existence of a single individual than it differs from one species, or even genus, to another. Hence I have some difficulty in understanding how Stein can so much blame Claparède and Lachmann for not having described the nucleus in the forms observed by them. Whenever I have thought I could see a nucleus it has appeared to me to be situated near the peristome, in the upper part of the body, and to present an oval form (Pl. XVII. fig. 4). Sometimes I have thought that I could distinguish a contractile vacuole in the inferior region of the body (fig. 4). But how is one to arrive at certainty with animals which swim and turn upon themselves with such rapidity, and only stop when they contract into a shapeless mass?

The test of our animals is composed of a hard slightly elastic material, which, however, breaks when the pressure is slightly increased. This substance resists acids even when tolerably concentrated, and presents no evolution of gas; therefore it is not an earthy carbonate. It burns away entirely at a dull red heat; hence it is not silica. It resists for a long time the action even of tolerably concentrated alkalies; consequently it is not a horny substance. There remains only chitine, to which we are led by the method of exclusion.

Leaving the description of the different forms observed until we come to speak of the genera and species, I shall only remark that the test generally presents two distinct layers, which, however, to all appearance, are of the same chemical composition. All the tests hitherto observed by various authors and by myself may be referred to three types which seem at the first glance very distinctly marked—namely, smooth tests, tests garnished with adherent foreign particles, and latticed tests. However, there are species which establish the transition between the smooth tests and the tests with adherent particles; and on the other hand, among the latticed tests, that which I have had the opportunity of observing was continuous, and only hollowed out by a number of small cavities on its outer surface. It was not perforated, which approximates it to certain smooth tests presenting patterns on their outer surface.

Notwithstanding all my researches, I have not succeeded in observing the reproduction of these animals. On the other hand, I have very frequently observed the initial act of the sexual reproduction of Infusoria, namely conjugation. It is well known that the Infusoria, after arriving at a certain point in their cycle of development, unite two and two and become more or less intimately amalgamated. The nuclei of the two copulated individuals also become amalgamated, and appear to exchange a part of their substance. After this act, which in its essential features corresponds to the fecundation of the Metazoa, the two individuals separate, and each of them reproduces by a phenomenon of total or partial scissiparity.

In the *Tintinni* the presence of the test is not an obstacle to conjugation. The individuals do not quit their tests in order to unite; they amalgamate by the margin of the peristome. The point of union is absolutely constant; it is situated in the vicinity of the mouth, but a little to the left of the latter, in such a way that two individuals in conjugation always form a perfectly symmetrical figure (Pl. XVII. fig. 3).

The union is tolerably extensive and very intimate, and lasts for several hours. During this time the copulated individuals cannot withdraw into their tests; they are condemned to remain in the state of extension; and although their natation is almost as rapid as that of the isolated individuals, this circumstance is none the less favourable to the study of the arrangement of the vibratile cilia of the disk. I believe that without these copulated individuals I should never have succeeded completely in unravelling the question of the mode of implantation of the cilia of the peristome.

Systematic Part.—The genus *Tintinnus* was established, if I am not mistaken, by Otto Friedrich Müller (I.). But under this name that author included a whole miscellaneous group of diverse forms described in a very unsatisfactory manner. Schrank (II.) and afterwards Ehrenberg (III.) circumscribed the genus, and took as its type (and this is important to note) a marine form, *Tintinnus inquilinus*, Schrank, to which Ehrenberg added a second (also marine) species, *Tintinnus subulatus*, Ehrenb.

Dujardin (IV.), again, confounded the *Tintinni* with another and very different genus, namely the *Vaginicolæ*, and grouped together animals some of them free, others sessile, and which had no real relationship. Neither this author nor his predecessors give us descriptions which enable us to distinguish with certainty the animals of which they speak, or especially to form any idea of their organization. It is only by means of the figures they give (which, moreover, are very rough) that we have been able subsequently to ascertain the species named by them.

Claparède and Lachmann (VII.) are the first authors who have given us any precise knowledge as to the structure of these Infusoria. They very justly take as the types the marine species described by Ehrenberg, and group round these first species a whole series of allied forms. They very well describe the form of the body, and the form and structure of the peduncle; they point out with perfect justice the important fact that the Tintinnodea have nothing comparable to the disk of the *Vorticellæ*, and that the vibratile cilia form several rows round the peristome. Where the disk of the *Vorticellæ* is situated, there is here only "a concave depression, the bottom of which goes rising towards the peristome, and becomes confounded with it." Claparède and Lachmann ascribe to all the Tintinnodea a ciliary coat covering the whole body of the animal. This assertion is too general; for there are species, indubitably belonging to this group, of which the body is absolutely smooth. Our authors describe fifteen new species, all of which they refer to the genus *Tintinnus*, at the same time remarking that the structure of the tests would allow the establishment of a series of generic divisions. In fact among the species which they describe there are some which have a gelatinous test, others an agglutinant test, others a test with small cavities on the surface, and, lastly, others with a delicate smooth test.

On the other hand Ehrenberg (VI.) separated from the *Tintinni* properly so called another genus, including three species and characterized by a test perforated like a trellis or grate. This genus received the name of *Dictyocysta*, Ehr.

So far all went well. The structure and history of the Tintinnodea were imperfectly known, it is true; but at least there were included under this name only forms the relationship of which was real and the characters of which were ascertained in their principal features. Then came Stein (VIII.), who, by an incredible confusion, introduced disorder into the whole characteristic of the group. In fact this naturalist found in the fresh waters an Infusorian with a very elongate test, sometimes free, sometimes fixed; this Infusorian has only a single spiral row of cilia on the peristome, a row which terminates in the pharynx. The surface surrounded by the peristome is smooth, and can be elevated and depressed like the piston of a pump. What does our author conclude from this? That this Infusorian belongs to some genus allied to the *Vorticellæ* but essentially different from the *Tintinni*? By no means! Stein concludes that he has before him the true type of the genus *Tintinnus*, the relationship of which he establishes in consequence, throwing doubt upon at least a part of the results of Claparède and Lachmann. Not being acquainted with the *Tintinnus fluviatilis*, I cannot pass any judgment upon the accuracy of Stein's description; I must accept it such as it is; and then it is evident to me that the German author has seen an animal very different from that which serves as type for the family, an animal which has no interest for us here, since it lies outside the scope of the present memoir. The conclusions which Stein draws from it, as to the characters of the genus *Tintinnus*, lead to error.

I specify still further. The authors who preceded Claparède and Lachmann made no observations upon the arrangement of the cilia surrounding the peristome. Claparède and Lachmann recognize that *Tintinnus inquilinus*, the type of the genus, bears several rows of cilia around a hollow peristome; and they give this character not only to the genus *Tintinnus*, but also to the family Tintinnodea. Our genus is and must remain so characterized; but we cannot place in it, as Stein has tried to do, forms of which the peristome presents totally different characters.

It is true that Stein observed a marine form which he refers to *Tintinnus inquilinus*, with the body destitute of small vibratile cilia, and, further, nearly the same organization as his *Tintinnus fluviatilis.* As the peristome is not described in detail, and in the complete absence of figures of any kind, it is difficult to judge of the real position of this *Tintinnus inquilinus.* Lastly, a third species, of which Stein proposes to form a genus *Tintinnopsis*, was ciliated over the whole surface of the body, and presented at the peristome two rows of vibratile cilia—an outer row composed of very long cilia, and an inner row of cilia one half shorter; the test was garnished with agglutinated grains. However, it is as well to note that Stein only observed individuals deprived of their tests; he refers them, it is true, to some empty tests found in the produce of the same gathering; but the reader may entertain some doubt as to the correctness of this collocation.

Lastly, Häckel (IX.) describes and figures various forms observed at Lanzarote and Messina. The author declares that the vivacity of these animals prevented his ascertaining all the features of their organization. Nevertheless he makes known a series of very curious and interesting facts. All the forms observed by our author are referred to two genera, namely the genus *Dictyocysta* of Ehrenberg, with a perforated test, and a new genus, *Codonella.*

The *Dictyocystæ* are represented as having a conical body, contracting regularly to the point of attachment, which is at the apex of the test, and with two rows of cilia on the peristome—an outer row of stout and long cilia, and an inner row of stout short cilia. Fortunately the description and the figure precisely belong to one of the species (*Dictyocysta cassis*) that I have had the opportunity of observing; the errors and deficiencies of Häckel's description cannot therefore serve to form a fictitious type, as so often happens. *Dictyocysta cassis* is not gradually attenuated towards its point of attachment, but presents a peduncle quite distinct from the body. The cilia of the peristome are not in two rows, but form a series of parallel spiroid lines, as I have described above. The large cilia of the margin of the peristome are much more numerous and shorter than Häckel figures them; and, finally, *the test is not perforated,* but only hollowed out in pits on its outer surface. It is true that these pits are so strongly marked and so deep that it seems at first sight like an open trellis, and very particular attention is necessary to recognize the continuous inner lamina which closes the apertures of the trellis.

The three other species of *Dictyocysta* described by Häckel have the test pierced with much larger apertures; and it seems to me difficult to believe that a continuous wall could have escaped observation had it existed. Provisionally therefore we shall consider these species as answering to the character given by Ehrenberg for the whole genus, whilst *Dictyocysta cassis* must be placed elsewhere. On comparing the figure of *Dictyocysta mitra*, Häckel, with the drawing given by J. Müller of the species named *D. elegans* by Ehrenberg, it seems to me that these two tests are identical; *D. mitra*, Häckel, will therefore be only a synonym.

The other forms observed by Häckel are referred to a new genus (*Codonella*), characterized by the presence on the peristome of a membrane in the form of a dentate collar, bearing about twenty appendages like little shreds, each of which is united to one of the teeth of the collar by a filiform part. Beyond this membrane there is a circular row of long motor cilia, twenty in number. Three species were observed, one of which had the body covered with little cilia, while the other two species have the body smooth. The test presents protuberances and regular striæ, and is covered in part with agglutinated siliceous particles. Häckel supposes that the forms described by Claparède and Lachmann, of which the tests resemble those of his *Codonellæ*, belong in reality to that genus. This appears to me very doubtful; for I have myself observed a species of Tintinnodean (Pl. XVII. fig. 5) of which the test much resembles that of *Codonella campanella*, Häck., and which, by the arrangement of the cilia of the peristome, proves to be a true Tintinnodean, and not a *Codonella*.

Häckel at once raises the two genera *Dictyocysta* and *Codonella* into two families distinct from the Tintinnodea: this is a rapid mode of doing business; and I believe that his family Dictyocystida in particular has no right to exist. As to that of the Codonellida, it may subsist, at any rate until the structure of the *Codonellæ* is better known.

I propose the following classification, which has no pretention to be any thing more than a provisional arrangement.

Family **Tintinnodea**, Clap. & Lachm.

Test in the form of a little bell, free. Animal conical, retractile, attached to the test by a retractile peduncle without striæ or distinct layers. Periphery of the body garnished with very fine vibratile cilia, or completely smooth. Superior extremity truncate, constituting a discoidal peristome, hollowed out like a saucer, garnished with motor cilia at the margin, and with short cilia towards the interior. Cilia of the peristome all arranged in accordance with about twenty curved lines, starting from the interior of the disk to become tangents to the margin of the peristome. Mouth large, excentrical; pharynx furnished with cilia by the prolongation of some of the rows of cilia of the disk. Nucleus situated in the anterior part of the body; contractile vesicle towards the middle of the body; anus near the point of insertion of the peduncle. Conjugation and internal formation of embryos observed in various species.

Genus 1. TINTINNUS, Schrank.

Test smooth, firm, chitinous, transparent, free from foreign bodies.

Tintinnus ampulla, sp. n.
(Pl. XVII. figs. 1–3.)

Test ovoid, terminated posteriorly by a slight projection in the form of a point, widely open above, where a widened, funnel-like portion is superposed upon the ovoid part. The widened portion composed of two zones, of which the superior is more turned out than the inferior one. At the boundary between the two zones, on the inner surface, there is a slight circular projection notched into the likeness of an arcade. Lines of cilia on the peristome to the number of twenty-four. Body smooth. Length of the test 0·087 millim.; diameter at the entrance 0·081 millim.

This species is the commonest of those that I have met with at Villefranche-sur-Mer. I have seen hundreds of it in the produce of my fishings.

Tintinnus spiralis, n. sp.
(Pl. XVII. fig. 4.)

Test greatly elongated, pointed, drawn out; the posterior third nearly cylindrical over a certain extent, very narrow, terminated by an acute point; the anterior two thirds in the form of an elongated cone, slightly inflated; near the orifice a thickening in the form of a cushion projecting outwardly. Test composed of two very distinct layers, presenting at the surface some faintly-marked and somewhat irregular striæ, generally parallel, oblique to the axis of the test, and describing very elongated dextrogyrous spirals; small points arranged in spiral lines parallel to the striæ, and alternating with them.

The cushion that surrounds the orifice is formed solely by the outer layer.

Animal short; peduncle much elongated, attached at a considerable distance from the apex of the test, or even presenting two points of attachment. Lines of cilia on the peristome to the number of about twenty; body smooth.

Length of the test 0·4 millim.; diameter of the orifice 0·09 millim.

I have met with only a small number of specimens of this delicate species at Villefranche.

Our genus, characterized as above, will in all probability include:—*Tintinnus inquilinus*, Schrank; *T. obliquus*, Clap. & Lachm.; *T. amphora*, C. & L.; *T. acuminatus*, C. & L.; *T. Steenstrupii*, C. & L.; *T. quadrilineatus*, C. & L.; *T. subulatus*, Ehr.; *T. cinctus*, C. & L.; and *T. urnula*, C. & L.

Perhaps it will be necessary to establish a special generic division for the species with a gelatinous sheath, such as *Tintinnus mucicola*, &c.

Genus 2. CONIOCYLIS, g. n.

Test with more or less marked transverse striæ, impregnated, especially in parts, with foreign mineral particles agglutinated and stuck upon its outer surface; posterior extremity generally drawn out.

Coniocylis campanula.

Tintinnus campanula (Ehr.), Clap. & Lachm.
(Pl. XVII. fig. 5.)

This species occurred repeatedly at Villefranche, but always only a very few specimens. The cilia of the peristome appeared to me to be arranged as in the other Tintinnodea.

Length of the test 0·14 millim.; width at the entrance 0·218 millim.*

It is in this genus that we must place *Tintinnus helix*, Clap. & Lachm., *T. annulatus*, C. & L., *T. ventricosus*, C. & L., and probably Stein's *Tintinnopsis*.

Genus 3. CYTTAROCYLIS, g. n.

Test continuous, but excavated at its outer surface by a quantity of deeper or shallower pits, often pretty regular and capable of giving the test the aspect of a trellis; posterior extremity generally pointed, frequently more or less turned to one side.

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* [From the figure these measurements appear to have been reversed.—EDS.]

Cyttarocylis cassis.

Dictyocysta cassis, Häckel.
(Pl. XVII. fig. 6.)

Test excavated at the surface with deep pits formed only by a delicate membrane, irregular, at least twice as large in the neighbourhood of the orifice as in the region of the apex; conical, suddenly widened out near the aperture.

Animal conical, attached by a peduncle to the apex of the test; peristome bearing twenty rows of cilia. Surface of the body smooth.

Length of the test 0·117 millim.; width at the orifice 0·078 millim.

It is in this genus, no doubt, that *Tintinnus denticulatus* and *T. Ehrenbergii*, C. & L., will have to be placed.

We reserve the name of *Dictyocysta* for the species in which the test is really perforated and reduced to a sort of open cage, such as *Dictyocysta elegans*, Ehr., *D. mitra*, Häck., *D. lepida*, Ehr., *D. acuminata*, Ehr., *D. templum*, Häck., and *D. tiara*, Häck.

As to *Tintinnus fluviatilis*, Stein, I have already expressed the opinion that it is not a Tintinnodean at all. The family Codonellidæ is differentiated by the small shreds of the margin of the peristome, although the tests very closely resemble those of the genus *Coniocylis*.

The relationship of our family is sufficiently indicated by the peculiar structure that I have described. It is clear that their relationship to the Vorticellina of which Stein speaks has no existence, and that our Infusoria differ still more from the *Vorticellæ* and Stentors than these do from each other. I shall not discuss the question whether the Tintinnodea should enter into the order Peritricha; for that order seems so little in accordance with nature that it can hardly be maintained. Stein himself seeks in vain to find a character common to all the families of which he composes this heterogeneous order. The definition that he endeavours to give of it degenerates into a casuistical statement in which the characters of all the families are enumerated, making the profound differences which separate them still more striking. If, notwithstanding, our author finds "an incontestable air of relationship" in all these creatures, this is an affair of sentiment; and this sentiment we are perfectly free not to share in.

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XXII.—*On* Viquesnelia atlantica, *Morelet & Drouet.*

By FRANCISCO D'ARRUDA FURTADO *.

[Plate XIII.]

THE history of the genus *Viquesnelia* is sufficiently well known, but may usefully be repeated here. It was founded by Deshayes, upon some fragmentary Roumelian fossils†. D'Archiac discovered another fossil representative of the genus in the Pyrenees‡. The only surviving species known are one native to India (*V. Dussumieri*, Fischer §) and a second found in the Azores; the latter is the subject of the present paper.

I have not been able to obtain Fischer's memoir on the Indian species; but the absence of any description of the animal in various conchological manuals, which at the same time make mention of the species, leads me to suppose that the detailed structure of *Viquesnelia* has not hitherto been made known*. The satisfaction with which I announce new results is qualified by the unpleasant necessity of criticising somewhat harshly the previous researches of Morelet and Drouet on the same subject. It is much to be regretted that these two naturalists, skilled observers and careful writers on other subjects, should have passed by the internal structure of an animal which is, to use their own language, "sans contredit le plus curieux de tous les mollusques Açoréens"†.

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* Translated, with notes, by Prof. L. C. Miall.

† ["Note sur un nouveau genre de Limacien fossile," par M. Deshayes, Journal de Conchyliologie, 2^{e} sér. tom. i. p. 283, pl. vii. figs. 14–17 (1856). The fossils in question (*V. lenticularis*, Desh.) were obtained by M. Viquesnel from rocks believed to be of the age of the Nummulitic Limestone, at Balouk-Keni, near Feredjik, Roumelia.—M.]

‡ [In a footnote to the paper cited above, Deshayes remarks that D'Archiac had found a *Viquesnelia*-stratum in the lower part of the Nummulitic deposit of the Pyrenees. This is apparently the authority for the statement in the text.—M.]

§ ["Addition à la Note sur le Genre *Viquesnelia*," Journ. de Conchyliologie, 2^{e} sér. tom. i. p. 290. In this short memorandum Fischer explains that some shells of Limacidæ obtained at Mahé by Dussumier are preserved in the Museum at Paris, and that Valenciennes had attached to them a label bearing the name *Clypeicella Dussumieri*. The species is now included in *Viquesnelia*.—M.]

MM. Morelet and Drouet examined the animal of *V. atlantica* without dissection. M. Morelet says:—"Malheureusement, dans le cours du voyage, le petit nombre de spécimens que nous avions recueillis s'est égaré, en sorte que je ne puis rien ajouter à la description des formes extérieures que j'ai donnée plus haut." Only the shell M. Morelet, like a true conchologist, took care not to lose; and this he describes minutely; the animal itself, though we are told that the specimens were lost on the voyage, is drawn by Lackerbauer as if from nature ("*ad nat.*")!

The descriptions of MM. Morelet‡ and Drouet§ differ notably, which is the more to be wondered at, as these authors conjointly founded the species, and as the memoir of M. Drouet, though later in the date of its publication, was based upon no additional materials: no second visit to the islands had been made; and the specimens collected during the first visit had, as we are told, been lost. M. Drouet's description comes nearest to nature; the figure is inaccurate and sketchy. Generic and specific descriptions based upon dissections are now offered to zoologists.

Fam. **Limacidæ**, Gray.

Gen. VIQUESNELIA, Desh.

Mantle large, submedian. *Tail* much compressed. *Respiratory orifice* on the right side, towards the hinder end of the mantle. *Caudal mucus-gland* absent. *Mandible* without ridges or teeth, its free edge forming a reentrant right angle. *Radula* very complicated. *Reproductive orifice* below and a little behind the right upper tentacle. *Capreolus*? *Flagellum* absent. *Dart-sac* absent. *Accessory glands* represented by a glandular layer surrounding the vagina. *Spermatheca* present. *Shell* rudimentary, concealed within the mantle, oval, depressed, with a rudimentary spire.

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* [Stabile (Moll. terr. du Piémont, p. 121) has proposed to remove *V. atlantica* to a new genus *Plutonia*, and this without any knowledge of the anatomy of the animal.—M.]

† [*V. atlantica* is noticed as the most remarkable Gasteropod of the Azores in Dr. H. B. Tristram's observations on the Terrestrial Mollusks of the Azores, contributed to F. D. C. Godman's 'Natural History of the Azores,' p. 107, London, 1870.—M.]

‡ [L'Histoire naturelle des Açores, suivie d'une description des Mollusques terrestres de cet Archipel: Paris, 1860.—M.]

§ [Elémens de la Faune Açoréenne: 1861.—M.]

Viquesnelia atlantica, Mor. & Dr.

Viquesnelia atlantica, Mor. & Dr., Hist. Nat. des Açores, 1860, p. 139, pl. i. fig. 1.

ANIMAL 25 millims. (1 inch) long, 3 millims. (⅛ inch) wide, elongate, compressed behind, narrowed towards the middle behind the mantle, tuberculo-rugose, chocolate-coloured to a greater or less degree in different individuals. *Mantle* entire, defining by its posterior border the posterior two fifths of the body, and almost as long as the tail when the animal is fully extended, rounded in front, gibbous over the shell (the place of which is indicated by a reddish patch), finely shagreened, in some individuals with large blotches of bluish colour. *Neck* about one fifth of the total length, thick, rounded, slightly curved longitudinally, narrowed in front, not exceeded by the foot, with large tubercles and two longitudinal furrows which extend to the bases of the tentacles; external to these grooves are two rows of large quadrilateral oblong tubercles; colour dull reddish, deeper on the sides, where it agrees with the ground-colour of the animal, brighter and pinkish above, with large yellow blotches along the upper part of each side. *Locomotor surface* narrow, parallel-sided, with two grooves, of a general bistre or sepia-colour, with minute dark spots, glistening. *Tail* much compressed, tolerably elevated, with oblique grooves intersecting so as to form polygonal lozenge-shaped or hexagonal areas which are raised and resemble plates; each plate has very many black shining elevations, which, when examined by a powerful lens, are seen to be small hemispheres sharply defined and resembling the eyes of a spider. At times the animal, when beginning to creep, raises the tail considerably in a peculiar way. *Tentacles*—the upper ones wide apart at the base, strongly divergent, two thirds the length of the neck, cylindrical but insensibly tapering, with a shagreen-like surface, deeply coloured, nearly opaque; terminal tubercles inconspicuous, obliquely truncate above; eyes very inconspicuous, black; the lower tentacles one quarter the length of the superior, brighter-coloured, much less divergent. *Head* with anterior surface subvertical, rounded, furnished with large tubercles.

DIGESTIVE SYSTEM.—*Buccal pouch* very long (as long as the stomach), pyriform-elongate, muscular layer well defined. *Mouth* hardly conspicuous, resembling when closed the letter **T** rather than the letter **Y**. *Mandible* with a cutting-edge forming a (reentrant) right angle, the attached border uniformly convex, translucent, yellowish, lateral tips sharp, with no ridges or teeth, but with visible lines of growth. *Tongue* strong, pointed, deeply concave, its sheath very prominent, straight, club-like, inclined downwards. *Radula* of strong conical or slightly depressed teeth in fifty transverse rows, each with about thirty teeth, forming chevrons which point backwards. *Œsophagus* about one third of the length of the stomach, gradually increasing in diameter backwards. *Stomach* curved, fusiform, twice as wide as the œsophagus, yellow, very pale in some individuals, with whitish longitudinal lines, which indicate internal rugosities. *Intestine* forming about half the length of the alimentary canal, equal in diameter to the œsophagus, whitish and partly transparent; its course simple, describing a letter N, nearly all of which lies in one transverse plane. *Salivary glands* largely developed, lying upon the anterior fourth of the stomach, quite separate from each other, white, lobed. *Liver* very large, bilobed, the larger lobe to the left, the anterior end curved round the central part of the stomach, the posterior end curved round the hermaphrodite gland; the smaller lobe applied to the hinder part of the intestine, sending a process into each bend, the posterior extremity lying along the rectum. The lobulation of the liver is conspicuous upon its lower surface; the colour uniform, bright and essentially composed of yellow and pink. The liver adheres strongly to the base of the stomach, and to the first part of the intestine.

REPRODUCTIVE SYSTEM.—*Hermaphrodite gland* very large, pyriform, of from five to six lobes, each of which consists of from ten to fifteen lobules; colour milky. The gland lies in the concavity formed by the curved posterior extremity of the larger lobe of the liver, and is partly enclosed by the small lobe. It adheres slightly to the liver, but is entirely free in some individuals. *Duct of hermaphrodite gland* large, twice as long as the gland, more or less sinuous, of uniform diameter. *Albuminiparous gland* unequally bilobed, convex posteriorly, excavated in front and receiving the duct of the hermaphrodite gland, subdivided into irregular lobules, position transverse. *Oviduct*—prostatic portion wide, sinuous, white, translucent, the dilated part remote from the albuminiparous gland, origin from gland not terminal; infraprostatic portion much curved, constituting nearly half the oviduct. *Spermatheca* spherical, attached to the anterior end of the uterus, its canal attached (externally) to the oviduct. *Vestibule* as long as the oviduct (neglecting the convolutions of the latter), variously curved or reduplicate. *Penis* short, depressed, situate in the middle of the vestibule, bifid, of a delicate yellow-pink colour; vas deferens entering the anterior lobe*.

SHELL.—I have nothing to add to M. Morelet's description, which is as follows:—"T. ancyliformis, oblonga, planata, rugosiuscula, longitudinaliter costulata, fulvescens; spira brevis, lateralis, postica, apice albido."

Note.—I have not found *Viquesnelia atlantica* in the gardens of Ponta Delgarda, where it was discovered by MM. Morelet and Drouet. The specimens upon which this memoir is founded were caught on Oct. 31, 1880, on the mountains near 7 Cidades, near the aqueducts of Muro do Carvão and Muro das 9 Janellas, on stones and overturned masses of *Sphagnum*. Specimens collected in the same neighbourhood in the month of May had the albumniparous gland so slightly developed that it was necessary, in order to complete the study of the reproductive organs, to wait for the breeding-season; in May the spermatheca was so small as to escape observation.

EXPLANATION OF PLATE XIII.

Viquesnelia atlantica.

Figs. 1, 2. Animal (nat. size).
Fig. 3. Occasional attitude when beginning to creep.
Fig. 4. Tail-end (magnified).

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* [It will be seen from M. Furtado's description that *Viquesnelia* is similar in anatomical structure to *Limax* and the allied genera. The mandible connects it with *Vitrina*, *Hyalina*, and *Limax*; and it would go with those genera into Mörch's "Oxygnatha" ("maxilla lævis, acie simplici"). It can hardly be doubted, however, that too much stress has been laid upon characters taken from the mandible. This is incidentally shown by M. Furtado in a paper entitled "Indagações sobre a complicação das Maxillas da alguns Helices naturalisados nos Açores" (Lisbon, 1880), in which he shows that in Azorean examples of *Helix pisana*, *lactea*, and *aspersa* the mandible is singularly variable and often differs conspicuously from Moquin-Tandon's description of the same organ in European specimens of what are believed to be the same species. The lingual ribbon seems to connect *Viquesnelia* with *Testacella*, to which it is otherwise only remotely allied. It is hardly possible at present to discuss the exact place of *Vitrina* and *Viquesnelia* in the long chain of genera and subgenera which intervenes between *Limax* and *Helix*, though they seem to approach the first genus rather than the second. Much anatomical research is required to define these forms and discover their mutual relations; and M. Furtado's paper is a welcome addition to the materials already collected.—M.]

Fig. 5. Median part of radula (magnified).
Fig. 6. Lateral part of radula.
Fig. 7. Marginal part of radula.
Fig. 8. Mandible (magnified).
Fig. 9. Reproductive organs. *hg*, hermaphrodite gland; *e*, its efferent duct; *alb*, albuminiferous gland; *od*, oviduct (prostatic portion); *od'*, oviduct (infraprostatic portion); *sp*, spermatheca; *vd*, vas deferens; *pe*, penis; *v*, vestibule.
Figs. 10, 11. Shell (magnified).

XXIII.—*Relation of Devonian Insects to Later and Existing Types.* By SAMUEL H. SCUDDER[*].

IT only remains to sum up the results of this reexamination of the Devonian insects, and especially to discuss their relation to later or now existing types. This may best be done by a separate consideration of the following points:—

1. There is nothing in the structure of these earliest-known insects to interfere with a former conclusion [†] that *the general type of wing-structure has remained unaltered from the earliest times.* Three of these six insects (*Gerephemera*, *Homothetus*, and *Xenoneura*) have been shown to possess a very peculiar neuration, dissimilar to both Carboniferous and modern types. As will also be shown under the tenth head, the dissimilarity of structure of all the Devonian insects is much greater than would be anticipated; yet all the features of neuration can be brought into perfect harmony with the system laid down by Heer.

2. *These earliest insects were Hexapods*, and, as far as the record goes, preceded in time both Arachnids and Myriopods. This is shown only by the wings, which in all known insects belong only to Hexapods, and in the nature of things prove the earlier apparition of that group. This, however, is so improbable on any hypothesis, that we must conclude the record to be defective.

3. *They were all lower Heterometabola.* As wings are the only parts preserved, we cannot tell from the remains themselves whether they belong to sucking or to biting insects; for, as was shown in the essay already referred to, this point must be considered undetermined concerning many of the older insects until more complete remains are discovered.

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[*] From the 'American Journal of Science,' Feb. 1881.
This summary of results is the conclusion of a memoir by Mr. Scudder "On the Devonian Insects of New Brunswick," published in the 'Anniversary Memoirs of the Boston Society of Natural History,' 1880.

[†] "The Early Types of Insects," Mem. Bost. Soc. Nat. Hist. iii. p. 21.

They are all allied or belong to the Neuroptera, using the word in its widest sense. At least two of the genera (*Platephemera* and *Gerephemera*) must be considered as having a closer relationship to Pseudoneuroptera than to Neuroptera proper, and as having indeed no special affinity to the true Neuroptera other than is found in Palæodictyoptera. Two others (*Lithentomum* and *Xenoneura*), on the contrary, are plainly more nearly related to the true Neuroptera than to the Pseudoneuroptera, and also show no special affinity to true Neuroptera other than is found in Palæodictyoptera. A fifth (*Homothetus*), which has comparatively little in common with the Palæodictyoptera, is perhaps more nearly related to the true Neuroptera than to the Pseudoneuroptera, although its pseudoneuropterous characters are of a striking nature. Of the sixth (*Dyscritus*) the remains are far too imperfect to judge clearly; but the choice lies rather with the Pseudoneuroptera or with *Homothetus*. The Devonian insects are then about equally divided in structural features between Neuroptera proper and Pseudoneuroptera; and none exhibit any special orthopterous, hemipterous, or coleopterous characteristics.

4. *Nearly all are synthetic types of a comparatively narrow range.* This has been stated in substance in the preceding paragraph, but may receive additional illustration here. Thus *Platephemera* may be looked upon as an Ephemerid with an odonate reticulation; *Homothetus* might be designated as a Sialid with an odonate structure of the main branch of the scapular vein; and under each of the species will be found detailed accounts of any combination of the characters which it possesses.

5. *Nearly all bear marks of affinity to the Carboniferous Palæodictyoptera*, either in the reticulated surface of the wing, its longitudinal neuration, or both. But besides this there are some, such as *Gerephemera* and *Xenoneura*, in which the resemblance is marked. Most of the species, however, even including the two mentioned, show palæodictyopterous characters only on what might be called the neuropterous side; and their divergence from the Carboniferous Palæodictyoptera is so great that they can scarcely be placed directly with the mass of Palæozoic insects, where we find a very common type of wing-structure, into which the neuration of Devonian insects only partially fits. For

6. *On the other hand, they are often of more and not less complicated structure than most Palæodictyoptera.* This is true of the three genera mentioned above with peculiar neuration, but not necessarily of the others; and it is especially true when they are compared with the genus *Dictyoneura* and

its immediate allies. There are other Palæodictyoptera in the Carboniferous period with more complicated neuration than *Dictyoneura*; but these three Devonian insects apparently surpass them, as well as very nearly all other Carboniferous insects. Furthermore,

7. With the exception of the general statement under the fifth head, *they bear little special relation to Carboniferous forms, having a distinct facies of their own.* This is very striking; it would certainly not be possible to collect six wings in one locality in the Carboniferous rocks which would not prove, by their affinity with those already known, the Carboniferous age of the deposit. Yet we find in this Devonian locality not a single one of Palæoblattariæ, or any thing resembling them; and more than half the known insects of the Carboniferous period belong to that type. The next most prevailing Carboniferous type is *Dictyoneura* and its near allies, with their reticulated wings. *Gerephemera* only of all the Devonian insects shows any real and close affinity with them; and even here the details of the wing-structure, as shown above, are very different. The apical half of the wing of *Xenoneura* (as I have *supposed* it to be formed) also bears a striking resemblance to the Dictyoneuran wing; but the base (which is preserved, and where the more important features lie) is totally different. The only other wing which shows particular resemblance to any Carboniferous form (we must omit *Dyscritus* from this consideration, as being too imperfect to be of any value) is *Platephemera*, where we find a certain general resemblance to *Ephemerites Rückerti*, Gein., and *Acridites priscus*, Andr.; but this is simply in the form of the wing and the general course of the nervules; when we examine the details of the neuration more closely, we find it altogether different, and the reticulation of the wing polygonal, and not quadrate as in the Carboniferous types[*]. In this respect, indeed, *Platephemera* differs not only from all modern Ephemeridæ, but also from those of other geological periods[†]. Another prevailing Carboniferous type, the Termitina, is altogether absent from the Devonian. Half a dozen wings, therefore, from rocks known to be either Devonian or Carboniferous would probably establish their age.

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[*] Dr. H. B. Geinitz has kindly reexamined *Ephemerites Rückerti* at my request, and states that the reticulation is in general tetragonal, but that at the extreme outer margin the cells appear in a few places to be elliptical five- or six-sided.

[†] The *Dictyoneuræ* and their allies, as may be inferred, are considered as belonging to the Palæodictyoptera, although their ephemeridan affinities are not

8. *The Devonian insects were of great size, had membranous wings, and were probably aquatic in early life.* The last statement is simply inferred from the fact that all the modern types most nearly allied to them are now aquatic. As to the first, some statements have already been made; their expanse of wing probably varied from 40 to 175 millims., and averaged 107 millims. *Xenoneura* was much smaller than any of the others, its expanse not exceeding 4 centims., while the probable expanse of all the rest was generally more than a decimetre, only *Homothetus* falling below this figure. Indeed, if *Xenoneura* be omitted, the average expanse of wing was 121 millims., an expanse which might well be compared to that of the Æschnidæ, the largest, as a group, of living Odonata. There is no trace of coriaceous structure in any of the wings; nor in any are there thickened and approximate nervules—one stage of the approach to a coriaceous texture.

9. *Some of the Devonian insects are plainly precursors of existing forms, while others seem to have left no trace.* The best examples of the former are *Platephemera*, an aberrant form of an existing family, and *Homothetus*, which, while totally different in the combination of its characters from any thing known among living or fossil insects, is the only Palæozoic insect possessing that peculiar arrangement of veins found at the base of the wings of the Odonata, typified by the arculus, a structure previously known only as early as the Jurassic. Examples of the latter are *Gerephemera*, which has a multiplicity of simple parallel veins next the costal margin of the wing, such as no other insect, ancient or modern, is known to possess, and *Xenoneura*, where the relationship of the internomedian branches to each other and to the rest of the wing is altogether abnormal. If, too, the concentric ridges, formerly interpreted by me as possibly representing a stridulating organ, should eventually be proved an actual part of the wing, we should have here a structure which has never since been repeated even in any modified form.

10. *They show a remarkable variety of structure, indicating an abundance of insect life at that epoch.* This is the more noticeable from their belonging to a single type of forms, as stated under the seventh head, where we have seen that their neuration does not accord with the commoner type of wing-structure found in Palæozoic insects*. These six wings exhibit a diversity of neuration quite as great as is found among the hundred or more species of the Carboniferous epoch: in some, such as *Platephemera*, the structure is very simple; in others, like *Homothetus* and *Xenoneura*, it is some-

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* *Cf.* Mem. Bost. Soc. Nat. Hist. iii. 19, note 1.

what complicated: some of the wings, as *Platephemera* and *Gerephemera*, are reticulated; the others possess only transverse cross veins, more or less distinct and direct. No two wings can be referred to the same family, unless *Dyscritus* belongs with *Homothetus*—a point which cannot be determined, from the great imperfection of the former. This compels us to admit the strong probability of an abundant insect-fauna at that epoch. Although many Palæozoic localities can boast a greater diversity of insect types if we look upon their general structure as developed in after ages, not one in the world has produced wings exhibiting in themselves a wider diversity of neuration; for the neuration of the Palæodictyoptera is not more essentially distinct from that of the Palæoblattariæ or of the ancient Termitina than that of *Platephemera* or *Gerephemera* on the one hand is from that of *Homothetus* or *Xenoneura* on the other. Unconsciously, perhaps, we allow our knowledge of existing types and their past history to modify our appreciation of distinctions between ancient forms. For while we can plainly see in the Palæoblattariæ the progenitors of living insects of one order, and in other ancient types the ancestors of living representatives of another order, were we unfamiliar with the divergence of these orders in modern times, we should not think of separating ordinarily their ancestors of the Carboniferous epoch. It may easily be seen, then, how it is possible to find in these Devonian insects (all Neuroptera or neuropterous Palæodictyoptera) a diversity of wing-structure greater than is found in the Carboniferous representatives of the modern Neuroptera, Orthoptera, and Hemiptera.

11. *The Devonian insects also differ remarkably from all other known types, ancient or modern; and some of them appear to be even more complicated than their nearest living allies.* With the exception of *Platephemera*, not one of them can be referred to any family of insects previously known, living or fossil; and even *Platephemera*, as shown above, differs strikingly from all other members of the family in which it is placed, both in general neuration and in reticulation, to a greater degree even than the most aberrant genera of that family do from the normal type. This same genus is also more complicated in wing-structure than its modern allies; the reticulation of the wing in certain structurally-defined areas is polygonal and tolerably regular, instead of being simply quadrate, while the intercalated veins are all connected at their base, instead of being free. *Xenoneura* also, as compared with modern Sialina, shows what should perhaps be deemed a higher (or at least a later) type of structure, in the amalgamation of the externo-median and scapular

veins for a long distance from the base, and in the peculiar structure and lateral attachments of the interno-median veins; in the minuter and feebler cross venation, however, it has an opposite character.

12. *We appear, therefore, to be no nearer the beginning of things in the Devonian epoch than in the Carboniferous*, so far as either greater unity or simplicity of structure is concerned; and these earlier forms cannot be used to any better advantage than the Carboniferous types in support of any special theory of the origin of insects. All such theories have required some *Zoëa*, *Leptus*, *Campodea*, or other simple wingless form as the foundation-point; and this ancestral form, according to Häckel at least, must be looked for above the Silurian rocks. Yet we have in the Devonian no traces whatever of such forms, but, on the contrary, as far down as the middle of this period, winged insects with rather highly differentiated structure, which, taken together, can be considered lower than the mass of the Upper Carboniferous insects only by the absence of the very few Hemiptera and Coleoptera which the latter can boast. Remove those few insects from consideration (or simply leave out of mind their future development to very distinct types), and the Middle Devonian insects would not suffer in the comparison with those of the Upper Carboniferous, either in complication or in diversity of structure. Furthermore, they show no sort of approach toward either of the lower wingless forms hypothetically looked upon as the ancestors of tracheate Articulata.

13. *Finally, while there are some forms which to some degree bear out expectations based on the general derivative hypothesis of structural development, there are quite as many which are altogether unexpected, and cannot be explained by that theory without involving suppositions for which no facts can at present be adduced.* *Palephemera* and *Gerephemera* are unquestionably insects of a very low organization related to the existing may-flies, which are well known to be of inferior structure as compared with other living insects; these may-flies are indeed among the most degraded of the suborder to which they belong, itself one of the very lowest suborders. *Dyscritus* too may be of similar degradation, although its resemblance to *Homothetus* leaves it altogether uncertain. But no one of these exhibits any inferiority of structure when compared with its nearest allies in the later Carboniferous rocks; and they are all higher than some which might be named; while of the remaining species it can be confidently asserted that they are higher in structure than most of the Carboniferous types, and exhibit syntheses of character differing from theirs.

It is quite as if we were on two distinct lines of descent when we study the Devonian and the Carboniferous insects: they have little in common; and each its peculiar comprehensive types. Judging from this point of view, it would be impossible to say that the Devonian insects showed either a broader synthesis or a ruder type than the Carboniferous. This, of course, may be, and in all probability is, because our knowledge of the Carboniferous insects is in comparison so much more extensive; but, judging simply by the facts at hand, it appears that the Carboniferous insects carry us back both to the more simple and to the more generalized forms. We have nothing in the Devonian so simple as *Euephemerites*, nothing so comprehensive as *Eugereon*, nothing at once so simple and comprehensive as *Dictyoneura*. On the derivative hypothesis we must presume, from our present knowledge of Devonian insects:—that the Palæodictyoptera of the Carboniferous are already, in that epoch, an old and persistent embryonic type (as the living Ephemeridæ may be considered today, on a narrower but more lengthened scale); that some other insects of Carboniferous times, together with most of those of the Devonian, descended from a common stock in the Lower Devonian or Silurian period; and that the union of these with the Palæodictyoptera was even further removed from us in time, carrying back the origin of winged insects to a far remoter antiquity than has ever been ascribed to them, and necessitating a faith in the derivative hypothesis which a study of the records preserved in the rocks could never alone afford; for no evidence can be adduced in its favour based only on such investigations. The profound voids in our knowledge of the earliest history of insects, to which allusion was made at the close of my paper "On the Early Types of Insects," are thus shown to be even greater and more obscure than had been presumed. But I should hesitate to close this summary without expressing the conviction that some such earlier unknown comprehensive types as are indicated above did exist and should be sought.

XXIV.—*On Siliceous Sponge-growth in the Cretaceous Ocean.*

By Surgeon-Major WALLICH, M.D.

A FEW days after the publication of the 'Annals' for February, I obtained a sight of Mr. G. J. Hinde's very interesting little work on Fossil Sponge-spicules found in the

Interior of a single Flintstone from Horstead in Norfolk, which had just previously been published at Munich.

In his concluding remarks the author, while referring to my paper on the chalk flints (Quart. Journ. Geol. Soc., Feb. 1880), expresses the opinion that "the contents of the flint from Horstead, and of those from the North of Ireland, prove" what I only "assumed, namely that in its original condition the cretaceous ooze was, like that of the Atlantic deep-sea mud, filled with the spicular skeletons of sponges . . . . the contents of both the Irish and Horstead flints showing that the sponge-spicules are as much intermingled with Foraminifera and other calcareous organisms as in the Atlantic ooze, and that therefore both these animal types flourished contemporaneously" (*op. cit.* pp. 80, 81).

Without in any wise detracting from the value of the concurrent testimony thus furnished as to the great exuberance and variety of the sponge-life which existed at the bottom of the ancient cretaceous sea-bed, the Horstead nodule, *per se*, would increase rather than diminish the force of the objections that have been raised by some writers to any analogy between the mineral composition of the ancient and the recent calcareous deposits. From a cursory remark made at the close of Mr. Hinde's observation, he appears ready to admit that the mass of the material in the flint-cavity under notice could not have presented its unconsolidated character had it, at the time of its inclusion, formed part of the deposit at any depth below the immediate surface-layer of the sea-bed. This is precisely what I have maintained and explained, in the only way it seems possible to explain it, by showing how the whole of the siliceous matter was continuously eliminated as the deposit was being formed, and was retained in a comparatively thin colloidal stratum that constituted, as it were, a floating layer overlying and resting upon large areas of the calcareous sea-bed.

It is obvious, therefore, that without probing the deposits to a much greater depth below their surface than we are likely ever to succeed in doing, the analogy that exists between the constituents of the ancient and recent calcareous deposits must continue to be based on assumption. Mr. Hinde's observations tend only to enhance the necessity of this assumption. They do not in the least degree assist us in "proving," as claimed, that "in its original condition the cretaceous ooze was, like that of the Atlantic deep-sea mud, filled with the spicular skeletons of sponges." Indeed, it would be well to bear constantly in mind that, so far as all the evidence goes that has heretofore been obtained, there is no warrant for

Mr. Hinde's conclusion that the Atlantic deep-sea mud *is* filled (as he seems to think) with these spicular skeletons except at its immediate surface. Hence the evidence furnished by the Horstead flint proves rather that, were it not for the special agency of the colloidal protoplasm and the conditions I have elsewhere fully described, the Horstead *Chalk*, in common with the rest of the Upper Chalk strata, must still have retained within its substance the silica which, under the prevailing conditions, entered into the formation of the stratified flints.

Mr. Hinde seems to have imagined that I disputed the contemporaneous existence of Sponges and Foraminifera. A reperusal of my first paper on the subject, and a glance at pp. 200–202 of my paper in the 'Annals' for Feb. 1881, will, I think, satisfy him that, so far from this being the case, the contemporaneous development of both these animal types constitutes an essential element in my hypothesis of the flint formation.

XXV.—*On* Spongilla cinerea.

By H. J. Carter, F.R.S. &c.

Having omitted to insert a description of *Spongilla cinerea* in my compilation of the "History and Classification of the known Species of *Spongilla*," in the last number of the 'Annals,' p. 88, after *S. cerebellata*, Bk., it is herewith supplied.

Spongilla cinerea, Carter.

Spongilla cinerea, Carter, No. 12, p. 82, pl. iii. fig. 5; No. 20, p. 30, pl. xxxviii. fig. 19.

Flat, spreading; surface slightly convex, presenting gentle eminences and depressions. Colour cinereous; texture compact, fine, friable. Skeleton-spicule curved, fusiform, gradually sharp-pointed, minutely spined. Statoblast globular; aperture infundibular; crust thick, white, composed of microcell substance charged with minute acerate spicules, which are curved, cylindrical, abruptly sharp-pointed, and coarsely spined throughout, arranged more or less tangentially, intercrossing.

Loc. Bombay.

Obs., The chief characters of this species are its cinereous colour and fine texture; its elementary parts are the smallest of any species that I have yet examined.

XXVI.—*Further Note on* Anomorhynchus (*or* Colossendeis) Smithii. By Edward J. Miers, F.L.S., F.Z.S.

I am indebted to the Rev. A. M. Norman for reference to a Pycnogonid described by Prof. G. O. Sars under the name of *Colossendeis augusta* in 'Archiv f. Mathematik og Naturvidenskab,' andet Bd., tredie Hefte p. 368 (1877), which I unfortunately overlooked, as no reference is made to the species, either in the 'Zoological Record' or the German "Bericht" in the 'Archiv f. Naturgeschichte' for 1877–78, but whose close affinity to *Anomorhynchus Smithii* was evident on a comparison of Prof. Sars's description with the types of the species from Franz-Josef Land. A second species, *Colossendeis proboscidea* (Sabine) = *Colossendeis borealis*, Jarzynsky, is referred to; but neither the page of Jarzynsky's descriptions nor any diagnosis of the genus is added.

In reply to an inquiry addressed to Prof. Sars on this subject, I learn that the genus *Colossendeis* was described by Jarzynsky in a memoir entitled "Præmissus catalogus Pycnogonidarum inventarum in mari glaciali ad oras Lapponiæ rossicæ et in Mari Albo anno 1869 et 1870." This memoir forms part of a preliminary list of the Echinodermata, Decapoda, Amphipoda, and Pycnogonida of the White Sea and Russian Lapland, of which a "separate copy" was communicated to Prof. Sars by its author. It bears date 1870, but has never been mentioned by the English or German recorders of carcinological literature, although its existence is adverted to by Dr. Lütken in his record of the literature of Echinodermata in 1872, by whom the title is not cited. No copy of it is in the British Museum; nor is it to be found in the library of either the Royal, Linnean, or Zoological Society.

Prof. Sars further informs me that his copy of this paper is without any indication of its place of publication. He believes this to have been in some one of the Russian periodicals; but I have been unable to find it in any to which I have access. He has, however, obligingly appended to his letter a copy of Jarzynsky's original descriptions, which leave no doubt that our species is *congeneric* with the types of the Russian naturalist. If, therefore, evidence be forthcoming of the regular publication of the memoir of Jarzynsky, the name *Anomorhynchus* will yield, on account of its later publication, to *Colossendeis**.

Prof. Sars, in his "Prodromus" in the Norwegian periodical above referred to, regards Jarzynsky's type (*Colossendeis borealis*) as identical with *Phoxichilus proboscideus*, a species

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* Prof. Sars believes that the genus *Colossendeis* is itself identical with *Rhopalorhynchus* of Wood-Mason—an opinion from which I must respectfully differ, in view of the widely-separated habitats of the types and of the distinctions mentioned in my paper.

long ago described by Sabine (Appendix Capt. Parry's Voyage, p. cxxvi), and *Anomorhynchus Smithii* (as I learn from his letter) as also referable to the same species. Sabine's species was unfortunately never figured; but I may note that our specimens differ from his descriptions in being destitute of eyes and without any distinct transverse line on the first segment of the body, and from that of Jarzynsky in having the first pair of appendages 9- (not 10-) jointed; nor do the words of the latter author—"Pedes (tenues) tarso longissimo (manu multo longiore); appendix caudata longissima cylindrica, extrema parte incrassata"—apply to our types. In other particulars his description is fairly applicable to *A. Smithii.*

From *Colossendeis augusta*, Sars, our species is apparently distinguished by the form of the rostrum, the relatively longer postabdomen, shorter conical oculigerous tubercle, and perfectly distinct claws of the accessory legs.

Sabine's original types of *Phoxichilus proboscideus* were found at ebb-tide on the shores of the North Georgian or Parry Islands, the type specimens of *Colossendeis borealis* near the shores of Russian Lapland ("ad oras Lapponiæ rossicæ exadverso insulis Gabriliensibus ad semi-insulæ piscatoriæ, maxima profunditate maris 120–250 org."). A single specimen is referred to by Prof. Sars as having been obtained in the cold area west of the Norwegian coast in lat. 62° 41′·5 N., long. 1° 48′ E., at a depth of 412 fathoms, by the Norwegian expedition in 1876 (*t. c.* pp. 337–368). *Colossendeis augusta* was obtained by the same expedition in lat. 63° 10′·2 N., long. 4° 59′·6 E., in 417 fathoms.

The examination of a larger series of specimens is needed to show whether the species above mentioned are all of them distinct; in the meantime, to avoid future confusion in the synonyma, I have thought it desirable to call attention to the memoir of the Russian naturalist, which has (excusably) been overlooked by nearly all the recorders of zoological literature[*].

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[*] Since this note has been in type, I have received from Dr. P. P. C. Hoek a paper containing an account of the Pycnogonids dredged during the cruises of the 'Willem Barents,' in the years 1878–79, reprinted from the 'Niederl. Archiv f. Zool.' Supplementb. i. (1881). In this paper a species is figured under the name of *Colossendeis proboscideus*, Sabine, with which, notwithstanding some slight differences, I must regard *Anomorhynchus Smithii* as very probably identical. The genus *Colossendeis* is not described by Dr. Hoek; but the memoir of Jarzynsky is cited as having been published in the 'Annales de la Société des Naturalistes de St. Pétersbourg,' 1870, a publication I have never seen. We are informed in Dr. Hoek's memoir that four female examples of *C. proboscideus* were recently collected by Mr. Murray of Edinburgh in lat. 60° 3′ N., between the north of Scotland and the Faröes; also numerous forms of the same genus inhabit southern latitudes (as shown by the rich materials collected by the 'Challenger' expedition), from all of which *C. proboscideus* is distinguished by its "highly concentrated" body.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 3, 1880.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Note on the Occurrence of Remains of Recent Plants in Brown Iron-ore." By J. Arthur Phillips, Esq., F.G.S.

The fossilizing ironstone described by the author occurs at Rio Tinto, in the province of Huelva, Spain, in close proximity to the celebrated copper-mines of that name, where it forms a thick horizontal capping of a hill known as the Mésa de los Pinos. In this iron-ore Mr. Carruthers has identified the following vegetable remains:—Leaves and acorns of *Quercus ilex*, Linn.; leaves and seed of a two-leaved species of *Pinus*, most probably *Pinus pinea*, Linn.; the cone of *Equisetum arvense*, Linn.; and a small branch of a species of *Erica*. There is also a well-marked leaf of a Dicotyledonous plant not yet identified. A great portion of many of the specimens consists of a thick growth of moss; but it is impossible to say what the species are. The whole is permeated with minute branching roots, showing that the vegetation was formed as a great mass, the oak- and pine-leaves having been probably carried or blown into it. The plants are evidently all of the same species as are still found growing in Spain.

The author attributes this deposit of ironstone to the decomposition, partly by organic agency, of ferruginous salts, derived from the oxidation of iron pyrites, which flowed into a marsh or shallow lagoon. Subsequently to this the valleys of the Rio Agrio and Rio Tinto were eroded, leaving the Mésa de los Pinos with its thick capping of iron-ore.

The very recent character of this deposit is evident from the fossils it contains; but the erosion of the valleys certainly took place before the Roman occupation of the district. This is satisfactorily shown not only by the position of various remains of that date, but also by the fact that the Roman grave-stones, which are still remaining in the locality, are made of this ironstone.

2. "Notes on the Locality of some Fossils found in the Carboniferous Rocks at T'ang Shan, situated, in a N.N.E. direction, about 120 miles from Tientsin, in the province of Chih Li, China." By James W. Carrall, Esq., F.G.S. With a Note by Wm. Carruthers, Esq., F.R.S., F.G.S.

The author described the locality from which he obtained some plant-remains of apparently Carboniferous age, and stated that mining-operations had been carried on by a Chinese company in the district since the year 1878. Several seams of coal occur, varying in thickness from 11 inches to 6 feet. Mr. Carruthers stated in a note that the specimens submitted to him belong to a species of

Annularia, probably *A. longifolia*, Brongn., abundant in the British Coal-measures, and found both on the Continent and in North America.

December 1, 1880.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communication was read:—

"On Remains of a small Lizard from the Neocomian Rocks of Comén, near Trieste, preserved in the Geological Museum of the University of Vienna." By Prof. H. G. Seeley, F.R.S., F.G.S.

The author mentioned that Prof. Kornhuber had described, under the name of *Hydrosaurus lesinensis*, the remains of a Lizard from the Neocomian rocks of the island of Lesina, off the coast of Dalmatia. The University Museum at Vienna contains a slab from a neighbouring locality, showing the hinder part of the skeleton of another Lizard, which had been lent to the author for the purpose of description by Prof. Suss. The specimen includes twelve dorsal and sixty-five caudal vertebræ; but the tail is incomplete. The sacral vertebræ are concealed, and the pelvis is imperfectly seen. Both hind limbs are fairly well preserved. The author described the distinctions which he considered to separate this animal from Kornhuber's species, consisting chiefly in the form and proportion of the dorsal vertebræ, which, instead of having the neural spine high and square as in *Hydrosaurus*, have it depressed and produced both anteriorly and posteriorly—in the length and slenderness of the ilium; in the single-headed character of the ribs—and in the form and structure of the segments of the limbs, which appear to possess four tarsal and three metatarsal bones and five digits. The author proposed to name this Lizard *Adriosaurus Suessii.*

December 15, 1880.—J. W. Hulke, Esq., F.R.S., V.P.G.S., in the Chair.

The following communication was read:—

"On a new Species of *Trigonia* from the Purbeck Beds of the Vale of Wardour." By R. Etheridge, Esq., F.R.S., President. With a Note on the Stratigraphical Position of the Fossil, by the Rev. W. R. Andrews.

In this paper the author described a species of *Trigonia* discovered by the Rev. W. R. Andrews in the "Cinder-bed" of the Middle Purbeck series in the Vale of Wardour. The specimens were found in the railway-cutting one mile west of Dinton station. The shell was referred to d'Orbigny's section "Glabræ" of the genus *Trigonia*, and named *Trigonia densinoda*. In its ornamentation it closely resembles *T. tenuitexta*, Lyc., of the Portland Oolite, but is more depressed and lengthened posteriorly, and destitute of the ante-carinal space which occurs in all known Jurassic "Glabræ." The escutcheon is remarkably large, and possesses transverse rugæ, as in the Neocomian "Quadratæ." The author regarded the species as a transition form connecting the two groups of *Trigoniæ* above mentioned. The description of the new species was accompanied by a note on the Purbeck strata of the Vale of Wardour by the Rev. W. R. Andrews.

BIBLIOGRAPHICAL NOTICES.

Fossil Sponge-Spicules from the Upper Chalk, found in the Interior of a Single Flintstone from Horstead Norfolk. By George Jennings Hinde, F.G.S. With five Plates. 8vo. Munich, 1880.

Under this title appears Mr. (now Dr.) Hinde's "Inaugural Dissertation" for the degree of "Dr. of Philosophy" in the University of Munich, published at Munich in the month of November 1880. For this he very wisely took some fossil sponge-spicules obtained from Horstead for comparison with those which Prof. Zittel has collected in the Palæontological Museum of Munich, and thus met with the disinterested generosity of one whose love for his profession goes hand in hand with his great ability for practising it.

With such aid it is no wonder that he should have produced a "Dissertation" alike honourable to himself and to those by whom he has been assisted, viz. Prof. Zittel and Herr Conrad Schwager, respectively superintendent and assistant in the Palæontological Museum at Munich—the former having assisted by his extensive knowledge and liberality, and the latter, among other things, by his aptitude in drawing with the camera lucida.

The "Dissertation" is illustrated by five plates, containing 165 figures, which, "as far as possible," have been drawn to the scale of "20 diameters," in order that "their relative dimensions" might be appreciated; while the measurements have been given in parts of a metre, that *they* may be most generally useful.

Commencing with a description of the kind of Upper-Chalk Flint in whose interior the sponge-spicules were found, viz. "a potstone or paramoudra," about a foot in diameter, with the mouth closed by extension of the flint,—the contents generally are enumerated; after which the structure and mineral composition of the fossil sponge-spicules are noticed in particular, ending with the following commendable enunciation, viz.:—"In several instances the correspondence in form and size of the spicules is so close to that of sponges already determined, that no doubt can arise of their belonging to the same species. Under these circumstances I have arranged these spicules under the different genera with which they seemed to have the closest relationship; and in only a few exceptional cases, in which the peculiar form or dimensions of the spicule rendered it highly probable that it belonged to some hitherto unrecognized sponge, have I ventured to give a name to it, to facilitate reference in the future" (p. 18).

Following the systematic arrangement which is given by Prof. Zittel in his "Beiträge zur Systematik der fossilen Spongien" (see 'Annals,' 1879, vol. iii. p. 304), Mr. Hinde begins his descriptions in detail with Zittel's "Monactinellidæ"—that is, sponges which consist only of "spicules which possess a single unbranched interior canal," which, so long as the monactinellid has a peculiar feature, answers very well for identification; but when the spicule is a simple acerate—that is, linear, more or less curved (for if looked at in a favourable direction it is seldom otherwise), fusiform, gradually sharp-pointed, and smooth, as in pl. i. figs. 1–3,—the power of the term continues for the spicule, but ends for that of distinction of species; for this form is perhaps of all the most common, and extends to totally different families. Mr. Hinde has evidently experienced this difficulty.

Again, the "Tetractinellidæ" of Marshall, characterized by spicules with "four arms or rays, one usually much longer than the others, radiating from a centre" (p. 24), might do for the Pachytragida (Carter), but no other sponges. So the "Siliceous Globules" (p. 38) may belong to *Placospongia melobesioides*, Gray, whose skeleton-spicules are pin-like, with the *points outwards*, thus, with other concomitants, allying itself to the Suberitida (Carter). The "Quadrifid Spicules of *Pachastrella*" are less open to difficulty in this respect; while the fully formed spicules of Zittel's "Megamorina" and "Tetracladina" (Lithistina), and those of the order "Hexactinellidæ (O. Schmidt)," are self-evident, both recent and fossil, as well as the incomplete ones of the former (pl. iv. figs. 24–34), which we now know to be only a transitionary state of the disk to the ulterior development of the Lithistid spicule. Here it is that Prof. Zittel, by his sagacity, success, and indefatigable labours both at home and in the field, has so enriched the Palæontological Museum of Munich—which, together with his numerous discoveries, quite marks an epoch in the early history of the Spongida; while the exquisite beauty of the fossil remains he has collected, once seen and begun to be studied, is so fascinating as to recall to mind the saying "*Vestigia nulla retrorsum.*"

Lastly, Mr. Hinde alludes to the destruction of the spicule, observing that "the peculiar form of the perforations (in the fossil spicule) shows that they have been produced by the action of some living organism," but different from that of Duncan's *Palæachlya perforans*.

Having gone through all the sponge-spicules of the "paramoudra" both descriptively and comparatively, not only with reference to the recent but the fossil sponge-spicules also, that have been made known, Mr. Hinde adds a most interesting "Summary" of his results, which must be read *in extenso* to be properly appreciated; nor can we fail to notice in the "Postscript" that desire to which we alluded in the beginning, viz. not to create new genera or species before making himself acquainted with what has already been published on both fossil and recent sponges.

Finally, we would observe that, with such principles and opportunities, under the able and willing guidance of Prof. Zittel, it is hardly necessary to add that Mr. Hinde's "Inaugural Dissertation" tells us most satisfactorily the state of sponge-development at the time the Upper Chalk was deposited.

Fossil Foraminifera of the Carboniferous Limestone.

1. *The Spirally-coiled Foraminifera of the Carboniferous Limestone of Russia.* By Valerian von Möller, Professor at the Mining Institute. [*Die spiralgewundenen Foraminiferen des russischen Kohlenkalks.*] *Mémoires de l'Acad. Impér. des Sci. de St.-Pétersbourg*, 7^e série, vol. xxv. no. 9, 1878. 4to. 148 pages, with 15 lithographic plates and 6 woodcuts.
2. *The Foraminifera of the Carboniferous Limestone of Russia.* By Valerian von Möller, Professor at the Mining Institute. [*Die Foraminiferen des russischen Kohlenkalks.*] *Mémoires de l'Acad. Impér. des Sci. de St.-Petersbourg*, 7^e sér. vol. xxvii. no. 5, 1879. 4to. 132 pages, with 7 lithographic plates and 30 woodcuts.

The great Carboniferous Limestone has long been known to contain, and indeed in places to consist of, Foraminifera, often of relatively large size. Fischer de Waldheim indicated the *Fusulina*, which Carpenter rightly removed in classification from the Imperforata to the Perforata group, and which H. B. Brady further elucidated and now refers to the Rotaline series. Ehrenberg illustrated several allied forms (*Borelis* &c.), which Parker and Jones (treating of his 'Mikrogeologie') interpreted and put into a regular series. He figured also other Foraminifera associated with the former. John Phillips long ago pointed out the leading *Endothyra*, of which genus numerous representatives are now known from H. B. Brady's researches. Rouillier, Vosinsky, and d'Eichwald added some of these and other forms; and Brady has not only interpreted these, but augmented the list with numerous highly important and well-systematized genera and species. All this fauna, excepting *Fusulina*, he describes and figures (44 species in 14 genera) in his "Monograph of the Carboniferous and Permian Foraminifera," Palæontogr. Soc., 1876.

In Professor Valerian von Möller's two memoirs before us we have some of the same or very similar forms (occurring in Russia), together with the *Fusulinæ* (in 4 genera with 14 species), treated of as 14 genera with 41 species.

These two elegant monographs are illustrated with numerous well-drawn, though sometimes bold and somewhat diagrammatic figures, altogether making twenty-two quarto plates, of the very interesting Foraminifera found in the Carboniferous Limestone of Russia, and, in most cases, of other countries also. Numerous clear woodcut diagrams, moreover, illustrate the text. The descriptive portions of these monographs bear evidence as well to great acumen and industry (indeed, energy and enthusiasm) on the part of the author, as to much friendly help and sympathy from his scientific colleagues and friends. The result has been a revision of what has been done in elucidation of this particular branch of palæontology among the Rhizopoda obtained from one of the latest of those which geologists term "primary" or "palæozoic" strata. This revision, however, has been ruled by views differing considerably from those of the observers who have preceded Prof. von Möller in this particular line of research. Examining with close attention the intimate structure and the external form of the minute shells he has had to do with, our author has been led to determine and note the *geometrical relationship* and *exact measurements* of spirals and chambers, and has made angles and proportions of greater importance in the specific characters of the organisms than his predecessors thought of doing. Had there been but few of the spiral (helicostegian) forms, and but few of those with alternating (enallostegian) chambers, some definite limits of size, form, and structure would have been far more easily recognized as of permanent occurrence among Foraminifera than are usually found to obtain. The gradations, however, in amount of angularity with the alternating chambers are even more insensible than those in the relative size and the setting-on of chambers, and in the modifications of septal aperture, in any series of Foraminifera. The nature of the dorsal spire, whether simple and either "concho-spiral" or "logarithmic-spiral," or compound and combining both kinds, is of importance in Von Möller's differentiations; and so also are the characters of the form and shell-structure. In this last feature, however, the discrepancies between his observations and those of H. B. Brady on apparently similar shells are so very great that, unless shell-structure varied with regional conditions, doubt must exist as to whether the author and his artists have quite mastered the intimate structure of the shells in every detail; for they have as much omitted the sandiness usually present in *Endothyra* &c. as Messrs. Brady and Hollick's drawings omit the large pores so numerous and regular in the Russian figures. H. B. Brady intimates (Monograph, Pal. Soc., p. 83) that *Endothyra* may essentially have a porous test, and that his specimens may have been modified by infiltration; but the absence of the true "arenaceous" condition in the Russian drawings is remarkable.

Von Möller makes more of the real Nummuline character of *Nummulina antiquior* than Brady seems to allow (Monogr. p. 148). The *Fusulinæ* are conveniently made into several species. One set is divided off (*Fusulinella*) as having an *Imperforate* instead of *Perforate* shell. "*Bradyina*" is a "porous" form collated with *Lituola Bennsana* as a synonym; but we have not seen it in the British collections, and in appearance and structure it differs from the *Lituola* quoted. "*Cribrospira*" would be a *Lituola* were its shell-structure sandy, instead of being porous like an immature *Valvulina*.

Among the non-spiral Foraminifera of the Russian Carboniferous series, Von Möller makes his genus "*Cribrostomum*" the most comprehensive, with eight species, differentiated by the angle at which the chambers are superimposed, as far as it can be calculated by the production of the probable planes beyond the side walls, thus giving the readings for the "species" in degrees. Taking other characters, however, into consideration, Brady had already treated the same or similar forms as Textularians, referring them to *Climacammina*, *Bigenerina patula*, and true *Textulariæ*. Indeed, as with other groups of *Textulariæ* having their own peculiar facies, there are both the special Clavuline modification (*Climacammina antiqua*) in the Carboniferous group and the Bigenerine (*B. patula*); and it seems uncalled for to thus break up and commingle, on mathematical or geometrical principles, what seems to be a good and well-defined generic Foraminiferal series. One or two varieties of *Haplophragmium* also seem to be mixed in with "*Cribrostomum.*" This, moreover, is a bad generic name, being founded on a feature present in several accepted genera of Foraminifera.

The topographical and general geological distribution of the forms described, as well as their special and relative abundance, are carefully treated of, and are shown in elaborate tables, by Prof. von Moller, who has hereby done some good service to the palæontology of Russia. T. R. J.

Aid to the Identification of Insects. Edited by CHARLES OWEN WATERHOUSE. Lithographs by EDWIN WILSON. London: E. W. Janson.

WE learn from the prospectus that the intention of the Editor of this work is to give "a series of hand-coloured lithographic drawings of insects of all orders" not previously figured—to be issued in monthly parts, each containing eight or nine small quarto plates. Three parts are now before us, illustrating five of the orders. That Mr. C. O. Waterhouse is the editor is a sufficient guarantee for the accuracy of the work. Mr. Wilson, the artist, is doing his part in a manner that leaves little to be desired; and the colouring is very carefully attended to. Such a work should do for entomology what the 'Botanical Magazine' has done for botany; and it is to be hoped it will receive sufficient support to induce the spirited publisher to continue the work beyond the twelve parts announced to complete a volume, which will contain "a systematic index, together with such remarks on the insects as may appear absolutely necessary."

Among the insects figured, attention may be called to:—*Nosoderma cordicolle*, an East-African beetle belonging to a remarkable group otherwise confined to America; *Latheticus oryzæ*, a small beetle recently found in rice in Calcutta and Arabia, and now imported into England; *Myrmecosis Saundersii*, a curious mimetic form, belonging to the Hemiptera; and the beautiful little *Homalus nanus*, one of the ruby-tailed flies (Chrysididæ) from the Ionian Islands.

MISCELLANEOUS.

On the Starfishes dredged in the deeper Regions of the Gulf of Mexico and the West-Indian Sea by the American ship 'Blake.' By M. E. PERRIER.

IN 1878 the number of species of Starfishes known from the region explored was twenty-seven; the collections of the 'Blake' bring the number of species to seventy, of which forty-three were unknown, while a considerable number must constitute new generic types. Most of the genera discovered by the 'Challenger' expedition are represented in the collections obtained in the West-Indian Sea, such as *Zoroaster*, *Korethraster*, and the curious genus *Pedicellaster*, Sars.—*Zoroaster* by two species already described by the author, *Korethraster* by a species distinguished by the membrane which unites its dorsal spines, and indicating a remarkable passage towards *Pteraster*, *Pedicellaster* by a species remarkable for the arrangement of its skeleton. These new species are named by the author *Korethraster palmatus* and *Pedicellaster Pourtalesi*.

Besides the new genus *Hymenodiscus*, already described by M. Perrier, he finds several others which present intermediate characters between different groups of Echinodermata. *Goniopecten* in the structure of the skeleton seems to belong to the Goniasteridæ; but its pointed ambulacral tubes and the form of the teeth exactly resemble those of *Astropecten*. Of this type the author distinguishes four species. The *Radiasteres*, brought up from a depth of 1800 metres, are large five-rayed starfish, with tufts of spines like those of *Solaster*, marginal plates like the Goniasteridæ, and ventral plates arranged in series as in some Asterinidæ. The *Ctenasteres*, which are still larger (nearly 0·3 metre in diameter) and come from a depth of 3500 metres, have six arms, resemble gigantic *Ctenodisci* destitute of ventral scales, and thus approach the Echinasteridæ. The *Marginasteres*, on the contrary, are small pentagonal Starfishes, which would be taken for *Asterinæ* if they had not marginal plates like those of the Goniasteridæ.

Archaster, common in all the great depths of the Atlantic, occurred peculiarly abundantly. The author refers to seven species, one of which, *A. mirabilis*, of very variable form, is represented by several hundred specimens. The Goniasteridæ are represented by eleven species, all new, among which are several belonging to the genus *Dorigona*, Gray. The new genus *Anthenoides* is intermediate between *Anthenea*, with large pedicellariæ and a naked skin, and *Pentagonaster*, with small pedicellariæ and a granular skin.

Several new forms of pedicellariæ occur. *Pentagonaster ternalis* has them with three branches. The *Luidiæ* present two, three, and even four branches; but the most remarkable are those of *Archaster mirabilis*. Two ossicles are placed opposite each other like two parentheses, and each of them has a comb of spines, forming a very complex prehensile organ. The author considers that this example leaves no doubt as to the homology of the pedicellariæ with the spines or calcareous granules of the skeleton in Echinodermata. He says that there is a remarkable concordance between the number of tentacles, the structure of the mouth, and the form of the pedicellariæ, which would seem to indicate the division of the Asteriadæ into two distinct great families. From his new researches it results that there is an agreement between the structure of the mouth and the number of rows of ambulacral tubes, an agreement rendered necessary by the relations with the mouth of the skeleton that separates these tubes; but the general structure of the skeleton and the form of the pedicellariæ do not accord with these data, and must be regarded as furnishing more general characters.—*Comptes Rendus*, January 10, 1881, p. 59.

On the Guliga of Borneo. By A. Hart Everett.

The Guliga, more commonly known as Bezoar, forms a recognized article of export from the Rejang and Bintulu rivers in the Sarawak territory. These concretions are chiefly obtained from a red monkey (a species of *Semnopithecus*), which seems to be very abundant in the interior districts of Borneo. A more valuable Guliga, called the "Guliga Landak," is obtained from the porcupine; but it is comparatively rare. The Sepoys stationed at Sibu Fort in the Rejang formerly exported considerable numbers of these calculi to Hindustan, where, in addition to their supposed efficacy as an antidote for the poison of snakes and other venomous creatures, they appear to be applied, either alone or in combination with other medicines, to the treatment of fevers, asthmatic complaints, general debility, &c. A few years ago, however, these men ceased to send any but the Guliga Landak, since their *hakims* had informed them that the concretions obtained from the monkeys had come to be considered of very doubtful, if any, value from a medicinal point of view.

The usual test for a good Guliga is to place a little chunam on the hand, and to rub the Guliga against it, when, if it be genuine, the lime becomes tinged with yellow. Imitations are by no means rare; and on one occasion that came to my own knowledge some Bakatans succeeded in deceiving the Chinamen, who trade in these articles, by carefully moulding some fine light clay into the form of a Bezoar, and then rubbing it well all over with a genuine one. The extreme lightness of a real Guliga and the lime test, however, are generally sufficient to expose a counterfeit Bezoar. The Sepoys and Malays apply various imaginary tests. Thus they assert that if a true Guliga be clasped in the closed fist, the bitter taste of the concretion will be plainly susceptible to the tongue when applied to the back of the hand, and even above the elbow if the Guliga be a good "Landak;" and a Sepoy once assured me that having accidentally broken one of the latter, he immediately was sensible of a bitter taste in his mouth.

Accounts vary very much among the natives as to the exact position in which the Guligas are found—some saying they may occur in any part of the body, others that they occur only in the stomach and intestines, whilst I have heard others declare that they have taken them from the head and even the hand! Bezoar-stones are sold by weight, the gold scale being used; and the value varies according to quality and to the scarcity or abundance of the commodity at the time of sale. The ordinary prices paid at Rejang a few years ago were from $1.50 to $2 per amas for common stones, and from $2.50 to $4 per amas for Guliga Landak. I have seen one of the latter which was valued at $100. It was about the size of an average Tangier orange, and was perfectly spherical. The surface, where not artificially abraded, was smooth, shining, bronze-brown, studded with numerous irregularly-shaped fragments of dark rich brown standing out slightly above the general mass of the calculus. Those fragments, in size and appearance, bore a close resemblance to the crystals in a coarse-grained porphyritic rock.

The common monkey-bezoars vary much in colour and shape. I have seen them of the size of large filberts, curiously convoluted and cordate in shape, with a smooth, shining surface of a pale olive-green hue. Mr. A. R. Houghton once showed me one which was an inch and a half long, and shaped like an Indian club. It was of a dirty greenish colour, perfectly smooth and cylindrical; and it had become aggregated around a portion of a sumpitan dart, which appears to have penetrated the animal's stomach, and, being broken off short, subsequently served as the nucleus for the formation of a calculus. The same gentleman had in his possession two Landak stones, one of which bore a close resemblance to a block in shape, and was of a bright green colour; and the second was of a rich chocolate-brown, and could best be likened in form to a constable's staff. One porcupine-stone, which was opened, was found to be a mere shell full of small brown shavings like shred tobacco.

The part of the island which produces these stones in greatest abundance seems to be, by a coincidence of native reports, the district about the upper waters of the Baluñgan (Batang Kayan). The story is, that the head waters of this river are cut off from its lower course by an extensive tract of hills beneath which the river disappears, a report by no means unlikely if the country be, as is probable, limestone. The people of the district have no communication with the lower course of the river, and are thus without any supply of salt. In lieu of this necessary they make use of the waters of certain springs, which must be saline mineral springs, and which the Kayans call "Suñgan." These springs are also frequented by troops of the red monkeys before mentioned; and the Bezoars are most constantly formed in the stomachs of these animals, "through their drinking the saline water." The hunters lie in wait about such springs; and, so runs the report, on the animals coming down to drink, they are able to guess with tolerable certainty, from external signs, which of the monkeys will afford the Guliga; and they forthwith shoot such with their sumpitans. I have this account, curious in more ways than one, from several quite independent sources.

In concluding these brief notes, I may remark that the widespread idea of the medicinal virtue of these concretions would lead us to suppose that there is some foundation for their reputation.—*Journal of the Straits Branch of the Royal Asiatic Society*, 1880, p. 56.

On the Histology of the Pedicellariæ and of the Muscles of Echinus sphæra, *Forbes.* By MM. P. Geddes and F. E. Beddard.

Although our knowledge of the general form and of the calcareous parts of the pedicellariæ of the Sea-Urchins is now nearly complete, thanks to the researches of O. F. Müller, Valentin, Perrier, A. Agassiz, Wyville Thomson, and several other naturalists, the information furnished by authors as to the histology of the soft parts of these organs is not equally exact. In the hope of giving more precision to the ideas on this subject, we have studied in detail the pedicellariæ of the large Urchin, *Echinus sphæra*, Forbes; and we will describe in a few words the principal results of the investigation.

On the ophiocephalous pedicellaria of Valentin the three adductor muscles, arranged in the form of a triangle, are attached, as is well known, to the calcareous apophyses of the three valves; but the fibres which unite the head of the pedicellaria to the club of the stem are not inserted upon calcareous parts, but terminate in an extremely remarkable fashion. Most of them are bent suddenly upon themselves before arriving at the level of the calcareous parts, and thus form a series of loops or meshes.

Two bundles only are prolonged further, interlace with the semicircular arcs of the valves, and terminate freely in a small tuft of meshes in the middle of the muscular triangle.

Quite distinct and separate from these bent fibres, alternating with them, and external to the calcareous parts, we find three parts of a still more curious structure. These are a sort of grilles or gratings, formed of fibres repeatedly bent, composing a series of meshes. These organs are not attacked by dilute acetic acid; they have the aspect of elastic tissue; and it seems probable that they function as antagonists of the adductor muscles, and serve to open the valves, somewhat like the ligament of an acephalous mollusk.

The tridactyle and gemmiform pedicellariæ contain these grilles; but they are very difficult to find, in consequence of their extreme delicacy. The fibres of the stem are not bent upon themselves, but attach themselves directly to the calcareous parts.

The head of the gemmiform pedicellaria is an extremely complicated organ. There is a gland outside of each valve; it is covered with two layers of muscular fibres and with a cylinder epithelium. These pedicellariæ are perhaps organs of urtication, for their calcareous valves terminate in a needle-point; or they may be organs for the secretion of mucus, as Mr. Sladen thinks, who has recently described the histology of this kind of pedicellaria in *Sphærechinus granularis* (Lam.)*.

At the commencement of histological researches the observations upon the structure of the muscles of the Echinodermata were always completely contradictory. Wagner, Siebold, and Johannes Müller described these muscles as being unstriped; Valentin, on the contrary, maintained that the muscles of the lantern and of the spines of the Urchin are striped; and De Quatrefages saw a striation upon the longitudinal muscles of *Synapta*. Baur contradicted these observations, whilst Leydig described a longitudinal and transverse striation in *Echinus* and *Holothuria*. Finally, in the last memoir on this subject, that of L. Frédéricq*, on the muscles of the lantern of *Echinus sphæra*, their striation is again denied. How are we to explain this utter confusion?

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* Ann. & Mag. Nat. Hist., August 1880.

By treating the muscles of the Urchin with different reagents and making a considerable number of preparations we have seen all the phenomena described by these authors. Frequently the adductor muscles of the valves of the pedicellariæ are distinctly striped; frequently also they do not show the least trace of striation. The same fact may be observed with the muscles of the lantern; for we have preparations which contain the simple fibres of Wagner and Frédéricq side by side with others of which the striation is as evident as in Valentin's drawings. Moreover by passing along a single fibre we very frequently find all possible gradations between the most distinct striation and its complete absence.

Our colleague, Mr. Haycraft, has just proposed a new theory upon the structure of the voluntary muscles †. In his view the fibrils are not simple cylinders, but they are slightly constricted at small intervals; and he asserts that their striation does not indicate a histological differentiation, but is simply an optical phenomenon produced by the unequal refraction that the light undergoes in traversing the fibril.

Without wishing to pronounce an opinion upon this theory from a general point of view, and without affirming that the striation of the muscles of the Echinodermata is due to the same cause as that of the muscles of the higher animals, we are convinced that the irregularity of the striation in the *Echinus* may be explained in the same way.

The fibres of the lantern show constrictions in perfect correspondence with the transverse striæ; when these constrictions follow one another very rapidly the striæ also approach each other; and when they become more widely separated the striæ show the same irregularity. Lastly the striæ and the constrictions disappear together.

It is probable, as has already been suspected, that the striation stands in some relation to the state of contraction of the muscles; but we hope to make fresh observations before pronouncing an opinion upon this question.—*Comptes Rendus*, February 7, 1881, p. 308.

On the Formation of the Blastoderm in the Araneida.

By M. A. Sabatier.

The mode of formation of the blastoderm in the Araneida has given rise only to a small number of publications, the data and conclusions of which are contradictory. The phenomenon presents two distinct phases: the first terminates in converting the egg into a meroblastic ovum with multiple cicatriculæ; the second includes the discoidal segmentation of each of the cicatriculæ, so as to form a simple and continuous layer of blastodermic cells.

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* Arch. de Zool. Expér. 1877.

† Proc. Royal Soc., February 1881.

The ovum, examined two or three hours after deposition, consists of a network of granular protoplasm, in the meshes of which are contained the spheres of the deutoplasm. The surface of the ovum is covered by a continuous layer of protoplasm, a layer the existence of which Ludwig has erroneously denied, and which he has confounded with the chorion covered with projecting granules. This layer divides very clearly into germinative areas, as was first described by Balbiani; and, notwithstanding the contrary assertions of Ludwig and Barrois, I have been able to grasp the mode of formation of this division, and to ascertain that it has a significance different from that ascribed to it by Balbiani. It is due to the transference of the protoplasm from the interior to the surface of the ovum. Hyaline protoplasm gushes forth in the intervals of the vitelline spheres of the surface, and divides the granular layer. This phenomenon has no particular influence upon the formation of the blastodermic cells. It is the result of a centrifugal tendency of the protoplasm, which governs the first phases of development in the Araneida.

A few hours after this division there appear at the surface of the ovum at first large, diffused, deep spots, and soon afterwards dark stellate figures, described by Balbiani, and surrounded by the brilliant rosettes of Ludwig. The dark stellate forms are true salient disks of granular protoplasm, having a large pale nucleus in their centre. Sections made at this moment show that the disks issue from trains or dissepiments of the same nature, which separate and englobe the neighbouring vitelline spheres.

In ova taken before the formation of the rosettes of the surface I have never ascertained the existence of the cylinders of deutoplasm, or "*Deutoplasmasaulen*" of Ludwig, in the interior of the ovum itself; and I do not think that we can adopt the opinions of that author as to the mode of segmentation of the ovum by the successive splitting of the central rosettes. What is really the case is that the protoplasm grouped around the nuclei moves from the interior towards the surface, drawing more and more towards it the protoplasm of the dissepiments, and producing first of all diffused spots, which become resolved into dark superficial rosettes.

From the examination of sections it appears :—1. That the granular protoplasm, at first diffused pretty uniformly in the form of a network between the spheres of deutoplasm, bears more and more towards the periphery of the ovum, at the same time concentrating around a small number of nuclei. 2. That the masses of protoplasm appear at the surface in the form of dark lenticular masses or disks, from which issue rays of the same substance, which separate the surrounding vitelline spheres and envelop them in the form of partitions. It is to the thickness of the interposed dark septa, and very probably also to the centripetal contraction of these septa, that these vitellne spheres owe the very strongly-marked appearance of their contours and the elongation of their axis towards the centre of the dark disk, conditions which produce the phenomenon of the brilliant rosettes of Ludwig. But these rosettes can only exist at the surface of the ovum, and when the dark masses and the dissepiments have attained a sufficient concentration. The central rosettes, or large rosettes of Ludwig, are purely imaginary phenomena, assumed (rather than observed) in accordance with an illegitimate analogy between the phenomena witnessed at the surface of the ovum and those which are supposed to take place in its depths.

To sum up, the protoplasm, in the Araneida, moves from the centre towards the periphery, where it makes its appearance in the form of disks or *cones of ejection*, surrounded by the spheres of the rosette, which may be compared to *cones of elevation*. There is *eruption* through a *chimney*, which subdivides towards the centre of the ovum. By this means the ovum is transformed into a meroblastic ovum with multiple cicatriculæ. This is the end of the first phase.

During the second phase the regular meroblastic segmentation of the cicatriculæ takes place. The nuclei divide, and with them the dark stellate forms, and the rosettes of Ludwig. In this way is produced a second generation of stars and rosettes. As this goes on the granules and the protoplasm of the germinative areas are attracted by the dark disks, which finally absorb them entirely. In the third generation the brilliant rosettes cease to be visible, which is due to the disappearance of the thick dissepiments of protoplasm and their absorption into the dark disks.

The protoplasm of the surface continues segmenting, and finally forms a single layer of flattened polygonal cells. This is the blastoderm, which covers the whole surface of the ovum.

In none of the species that I have studied have I found the central cavity or blastocœle, any more than the radial orientation of the vitelline masses, such as are described and figured by Ludwig.

From these observations it results that the ovum of the Spider presents an intermediate type between the ova with general superficial segmentation of the Crustacea, such as *Peneus*, and the ova with regular discoidal segmentation, such as those of certain fishes; that is to say, it has a blastulation intermediate between periblastulation and discoblastulation. It greatly approaches the ova of *Chelifer* (Metschnikoff), *Tetranychus* (Claparède), and of insects (Bobretzky). Thus is plainly manifested from the outset the affinity of the Araneida with other groups of Arachnida and with the insects.

My observations have been made upon the ova of *Pholcus opilionides*, *Epeïra diadema*, *Epeïra fasciata*, *Agelena labyrinthica*, *Latrodectus malmignatha*, and some small undetermined species.—*Comptes Rendus*, January 24, 1881, p. 200.

Acineta dibdalteria, *a new Species of Marine Infusorian from the Gulf of Genoa.* By Dr. Conrad Parona.

When seeking Protista at Sestri Levante (Riviera di Genova) and in the sea-water that I had brought home with me for subsequent study, I found last September a new Acinetine, which struck me by its very peculiar characters, and especially by the suckers, which are not borne by a trunk and are not ramified.

I ascertained at once that I had to do with a form of the genus *Acineta*. We find this *Acineta* solitary and attached by means of a slender peduncle to the various Algæ; and it is tolerably abundant. The test, protoplasm, and nucleus did not greatly engage my attention; but the suckers are very remarkable: in fact, instead of being of a certain number, collected into bundles and arranged symmetrically on one side and the other of the body, or distributed over the whole of the free surface of the protoplasm corresponding to the aperture of the test, they are only two in number, placed opposite one another. Whilst in the other *Acinetæ* these sucking-tentacles are slender, more or less long, and usually rigid, in this they are flexible in all directions and very mobile, so that we see them move and twist about continually.

In accordance with these remarkable characters, which I have not met with in any *Acineta* hitherto described, I think I may establish, if not a new genus (so as not to complicate further the divisions of this group), at least certainly a new species, under the name of

Acineta dibdalteria, sp. nov.

Diagnosis. Test in the form of a wine-glass; peduncle slender; tentacles of a single kind; protoplasm granular, more transparent at the periphery; contractile vesicle large; nucleus in the shape of a horse-shoe, and placed towards the lower part of the protoplasmic mass. Only two tentacles, which are at the same time suctorial and prehensile, movable in all directions; peduncle straight, slender, of uniform diameter, and only a little widened towards the base to attach itself more firmly to the plant which bears it.

Dimensions.

	millim.
Transverse diameter of the test (maximum)	0·06
Vertical diameter of the test	0·05
Length of the peduncle	0·03
Breadth of the peduncle	0·01
Length of the suckers	0·04

From these characters it seems to me that this form cannot be confounded with its congeners. In fact, if we run over the figures of those which are at present known, we shall see that none of them approaches the species just described. In reality there is no *Acineta* that presents tentacles reduced to two only.

We have here a very remarkable example of anatomical and functional retrogression. The organs having been reduced, the functions have been concentrated. The differentiation of the suctorial and prehensile tentacles having ceased or being absent, the two correlative functions have been compelled to combine in the same organ, which, in its turn, in order the better to perform its now multiple part, has been obliged to modify and adapt itself. We have evidence that this must have taken place when we find that whilst in the other Acinetæ the tentacles are usually rigid and motionless, in the present case, as we have already said, they are flexible and movable in all directions.—*Bibliothèque Universelle; Archives des Sci. Phys. et Nat.*, February 15, 1881, p. 181.

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XXVII.—*Contributions to the Study of the British Palæozoic Crinoids.*—No. I. *On* Allagecrinus, *the Representative of a new Family from the Carboniferous Limestone Series of Scotland.* By P. HERBERT CARPENTER, M.A., Assistant Master at Eton College, and R. ETHERIDGE, Jun., of the Museum of Natural History.

[Plates XV. & XVI.]

1. *Introduction.*

WE have for many years been in the habit of meeting with a very small and peculiar Crinoid in almost every collection of Scotch Carboniferous-Limestone fossils examined by us, in which attention has been paid to the remains of the more minute organisms that inhabited the old Carboniferous seas.

The systematic position of our fossils will be best discussed at the conclusion of this paper, after we have described the remarkable combination of characters which they present. We believe them to represent the type of a new genus, for which we propose the name *Allagecrinus*[*], on account of its singularly protean nature. We cannot even refer it to any known family of Crinoidea, although in many respects it approaches the Haplocrinidæ very closely.

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[*] ἀλλαγή, change.

The sources from which our material is derived are two. The ample and fine collection of Dr. J. S. Hunter, of Braidwood by Carluke, has supplied us with two well-preserved examples of the calyx. In the second place, we have been permitted to use a very large series of specimens, showing all stages of growth, from the collection of the Geological Survey of Scotland. The examples in question were collected and washed from shale by Mr. James Bennie; and we are indebted to the kindness of Prof. A. Geikie, LL.D., F.R.S., for the loan of them.

In the descriptions which follow we have united under the one name a series of forms possessing up to a certain point in their organization the same general structure, but beyond this differing in minor degrees, which we were at first sight inclined to look upon as probably of specific value. The finding of a regular gradation, however, between the extreme forms of the series has led us to reconsider this view; and we now think the additional points of structure referred to may be looked upon simply as an advance from a less to a more complex condition in the same form.

2. *Description of the Genus and Species.*

Genus ALLAGECRINUS, Ether & Carp. (gen. nov.).

Gen. char. Calyx pyriform or cylindro-conical, composed of five basals and five unequal radials, one to four of which, or sometimes none, *may* be axillary. An oral pyramid of five closely fitting valves, and of very variable height, is present in the young, but is probably wanting in the adult. Arms composed of elongated joints, sometimes forking twice. Stem short and vermiform, of low rounded joints; canal circular; terminal faces slightly granular.

Obs. Although the various individuals figured on Plates XV. & XVI. differ from one another to a very considerable extent, both in size and form, we have been led to the conclusion that they are really all referable to one species and represent various stages in its development. The most advanced, and probably fully grown, stage is shown in Pl. XV. figs. 1, 2, and 6. These are the only three tolerably complete specimens of the adult that we have met with, and were all found at the same locality. Fig. 2 represents that which is most fully developed and also the best preserved of the three.

A projection of the calyx and the arm-bases in connexion with it is shown in fig. 3 of the same Plate.

There are only two rows of plates in the calyx, which is cylindro-conical in form, expanding slightly from below upwards. The basals form a complete ring and a very shallow pentagonal cup, but little higher at the angles than at the sides; the sutures are nearly if not quite invisible as a general rule. Fig. 4 (Pl. XV.) represents the interior of this cup as seen from above. The five radials which rest upon it are elongated pieces with subparallel lateral margins, increasing slightly from below upwards both in width and in convexity. They vary considerably in size, some of them being axillary and bearing two arms, while others are narrower and have only one articular facet on the upper surface (Pl. XV. figs. 2, *a*, 2, *b*). In two specimens (Pl. XV. figs. 1–3) four of the radial plates are wide and axillary, so that the number of (primary) arms must have been nine. In the third specimen, however (Pl. XV. fig. 6), only three of the radials are axillary, corresponding to eight primary arms; while the two adjacent ones, which bear but one arm each, are unequal in size (Pl. XV. fig. 6, *b*). The articular facets for the attachment of the arms are large and distinct (Pl. XV. fig. 6, *a* & *b*), and nearly horizontal in position, so as to give a projecting lip-like appearance to the upper and outer edges of the radials. They have the same general form in all three specimens, although a certain amount of variation is perceptible. The dorsal fossa for the elastic ligament is narrow and crescentic, and lacks the central pit, which is often so very distinct in other Crinoids. Above it is the transverse articular ridge expanding around the opening of the central canal, which is unusually large. On the upper side of the ridge are large fossæ for the articular ligaments, which vary somewhat in shape in the different specimens.* The muscular fossæ, in the few cases in which they are discernible, are small and at a lower level than the ligamental fossæ, from which they are separated by ridges.

Two of the specimens have the lowest joints of the arms preserved. They are small and irregularly cuboidal, with nearly circular distal faces (Pl. XV. figs. 2 & 6). In the best specimen the second and third brachials of three arms are also preserved (Pl. XV. figs. 2, 3). Each joint has an almost cylindrical shaft, with slightly expanded ends. Where the first radial is axillary, the second brachial is not much longer than wide; but in the second brachial of the azygos arm the length is more than twice the width. This may, however, be merely an accidental difference; for the three third brachials vary considerably in size. Neither of these is an axillary; but their terminal faces are almost transverse to their longer axes, and seem to have been syzygial rather than articular. No traces either of vertical or transverse ridges are visible.

In none of the specimens is there any indication of an anal aperture.

The interior of the calyx between the radials is occupied by matrix; but there are no signs of its having been roofed over by a closed dome or vault of any kind. Had such a structure existed within the circle of radial plates, it would assuredly have been preserved in the original of fig. 2, together with the ring of first brachials. It is possible, however, as we shall point out later on, that the mouth was surrounded by a circle of oral plates, disconnected from the calyx like those of the recent *Rhizocrinus* and *Hyocrinus*.

The column is short, and when tolerably entire has a vermiform appearance (Pl. XV. figs. 2, *a*, *b*, & 7, *a*). It is composed of small, low, rounded joints fitting closely together. Each segment is biconcave, with a thickened margin, and the centre a little raised around the small circular canal, where the surface is also minutely frosted or granulated (Pl. XV. fig. 5).

The surface of the plates is minutely pitted.

The three specimens we have now described are from one locality, together with another in a much broken condition, and several fragments of other individuals. None similar have been met with elsewhere.

Other localities, on the contrary, have yielded a very large number of small specimens, the general appearance of which is so like that of the preceding examples that we have been led to regard them as the younger stages of the same, or of a closely allied species. They are all characterized by the presence of an oral pyramid, the relative size of which is greater the smaller the specimen. The various figures on Pl. XVI. and figs 7, *a*, *b* of Pl. XV. represent a number of these specimens of various sizes and at various stages of development. Great as is the contrast between the originals of figs. 1 and 2 (Pl. XVI.) and those of the corresponding figures on Pl. XV., there are so many intermediate stages which pass gradually into one another that we are unable to regard the series as comprising more than one species.

We may commence the study of this interesting developmental series with the smallest and least advanced forms, such as are shown in figs. 1–3 (Pl. XVI.). The youngest condition we have met with is shown in fig. 2 (Pl. XVI.). The calyx is covered by a round dome of oral plates, the height of which relatively to that of the radial plates is greater than in any other specimen we have seen. Its base is very nearly as wide as the summit of the radial pentagon, which is thus almost entirely concealed. At the centre of the upper edge of each radial is a minute opening, which penetrates beneath the dome; but no arm-facet corresponding to this opening is visible. The oral plates are so closely united that there is no trace of the sutures between them, though there are five faint grooves on the upper surface of the dome, which indicate their median lines. In older specimens, figs. 4, 7, 8, 10 (Pl. XVI.), these grooves are sometimes very marked. In this youngest individual the calyx is tolerably symmetrical, no one part being further developed than another. The same is the case in some older individuals, as is shown in figs. 5 and 7 (Pl. XVI.). On the other hand, specimens are not uncommon with some of the radials more developed than others. The youngest stage in this condition that we have met with is shown in fig. 1 (Pl. XVI.). The oral plates in this specimen are relatively lower, but cover the radials more completely than in the original of fig. 2, and their median grooves are much more distinct. Three of the radials have rudimentary arm-facets; but on the other two there is scarcely any more indication of these structures than in the specimen represented by fig. 2 (Pl. XVI.).

A larger and more advanced individual in the same condition is shown in fig. 3 (Pl. XVI.). The dome of oral plates is remarkably flat; and three of the radials have minute semicircular arm-facets, which are much less distinctly visible in the two remaining radials.

The next stage, in which the arm-facets are equally developed on all the radial plates, is exhibited in figs. 4–7 (Pl. XVI.). The calyx, which varies considerably in form, is surmounted by a low rosette-like dome, composed of the five very closely ankylosed orals. Each of these plates is triangular in shape and excavated rather deeply along its median line. At the centre of the dome they are in close contact laterally, so that no opening is visible; but their basal angles are more or less truncated, leaving a superficial gap between every pair of plates, which corresponds in position with the articular facet on the subjacent radial. The interior of this gap, however, is filled up by the deeper portions of the oral plates, which thus bridge over the semicircular notch on the upper surface of the facet. The latter consists of nothing more than a thickened semicircular rim, which is thus converted into the opening of a tunnel that leads inwards beneath the dome.

These notches on the upper surface of the radial plates are the central ends of the grooves which are excavated in the upper surface of the arm-joints, and were called the arm-grooves by Müller. They are often, although incorrectly, spoken of as the ambulacral grooves. Above and partly contained in these grooves were the vascular and generative tubes of the arms, and above all these the true ambulacral or food-grooves, which may or may not have been protected by special plates, as in *Cyathocrinus* and many other fossil and recent Crinoids. All these structures entered the calyx on their way to join their respective circumoral centres through the openings at the edge of the vault between the radials and the orals. These openings are of course the representatives of the ambulacral openings round the edge of the vault of *Actinocrinus*; but there is no trace in *Allagecrinus* of any such separation of the soft parts by plates as we find in the former genus. In both cases the cœliac canal, which was lodged in the lowest portion of the arm-groove, is continued directly downwards into the visceral cavity. It was separated in *Actinocrinus* from the water-vessel and food-groove by the subambulacral plates, which form the floor of the ambulacral tunnels beneath the vault; but there is no trace of these in *Allagecrinus*.

In none of these small specimens is there any trace of an anal opening, either directly piercing an oral plate, or at the margin of the dome, between the orals and the radials. The central end of one or more of the former may be marked by faint tubercles (figs. 5 and 7, Pl. XVI.); but we cannot suggest any explanation of these. In the specimen shown in fig. 6 the central portion of the dome has been removed, and only the bases of the triangular oral plates are visible.

Except in the characters of the stem, and in the general aspect of the basals and radials, these small specimens differ so much from the larger ones previously described that it would seem only natural to place them in entirely different families, characterized respectively by the presence or absence of an oral pyramid. Fortunately, however, we have met with a few specimens that show us such a gradual transition between the two groups that we have been compelled to place them together under one specific name.

These intermediate forms, which are represented in Pl. XV. fig. 7, and Pl. XVI. figs. 8–10, while agreeing in certain general characters, seem to have developed along different lines. The radial plates are better developed relatively to the orals than in the younger forms. Hence when the calices are viewed from above they are seen to be only very incompletely covered by the dome and project considerably beyond its circumference, while distinct facets for a true articulation with the first arm-joints begin to make their appearance (Pl. XVI. figs. 9, 10). These are least marked in the specimen shown in fig. 8 (Pl. XVI.). In one or two cases the facet is something more than a mere thickened rim to the arm-groove, and shows traces both of a central canal and of a dorsal fossa for the elastic ligament. The chief character indicating the advanced condition of this specimen is the inequality in the size of its radial plates, one of which is axillary and has two arm-facets, which are not yet completely developed. In the individual shown in fig. 10 (Pl. XVI.), on the other hand, all the radials have well-developed articular facets, which are pierced by the openings of the central canals; but though the radials are unequal in size, none of them is an axillary. The great reduction of the relative size of the orals in this specimen is especially noteworthy. In two other specimens, which also have much-reduced orals, there is a remarkable inequality in the development of the arm-facets. Thus, in the original of fig. 9 (Pl. XVI.) three of the radials have well-marked articular surfaces for the first arm-joints, while that of the fourth is very imperfect, and that of the fifth altogether undeveloped, no trace even of an arm-opening being visible. Fig. 7 (Pl. XV.) shows a similar irregularity. The orals are relatively very small, and two of the radials have distinct articular facets, whilst two others have small cuboidal brachials still in contact with them. The fifth radial, however, bears a very small and rudimentary brachial, which is shown on the right of fig. 7, *a*.

The originals of fig. 6, Pl. XV., and figs. 1 and 2, Pl. XVI., differ very considerably in size. Apart from that, the chief point of difference is the presence of oral plates in the latter and not in the former. It does not seem to us a very improbable supposition that during the growth of the smaller specimen to the size of the larger its orals would come to be of such small relative size (as they do in the development of *Comatula*) as to be altogether lost in the fossil state, even if they persisted during adult life.

The large and small forms agree in so many points, especially the inequality in size of the radials, and the fact that some of them may be axillary, that we do not see our way to separating them specifically. It must be remembered that these little fossils occur at various localities. Even the larger and more fully developed forms are at a very low stage of organization* as compared with most other Crinoids; so that it is natural to suppose they would present a considerable amount of variability, both local and general.

Although it may be thought that the variations we have described exceed the widest limits allowable on these grounds, we prefer rather to ask for an extension in this direction than to multiply species in a manner which appears both artificial and unnecessary.

When all the above facts are taken into consideration, it seems to us hardly possible to doubt that the specimens we have described represent various stages in the development of a Palæozoic Crinoid. In the smallest examples there is a relatively large oral pyramid, and the uniformly sized radial plates were not perforated by a central canal. The axial cords lay at the bottom of grooves in their upper surfaces, just as in the young Pentacrinoid larva of *Comatula* (with closed oral pyramid) and in the mature stages of many Palæocrinoids. Next we find specimens in which there are distinct canals developed for the axial cords, and the articular facets of the radials gradually come to exhibit their characteristic markings. At the same time the sizes of the different radials become more or less unequal, and the orals relatively less prominent, though still resting directly on the radials.

Lastly, in the best-developed examples the radials have strongly marked articular facets—some of them (never all) being axillary and bearing two arms, while the orals have entirely disappeared as an integral part of the calyx. In fact, one would scarcely expect to find them retaining their embryonic condition of a closed pyramid on the top of a calyx, the radials of which had reached such a high state of development.

The very complete fusion of the orals in the specimens represented in figs. 8–10 (Pl. XVI.) appears to show that they remained united until a comparatively late stage, and so closed in the tentacular vestibule, in the floor of which was the opening of the mouth.

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* Beyrich has pointed out (Crinoideen des Muschelkalks, pp. 43, 44) that in young individuals of *Encrinus* the sutures between the basals are invisible, though those between the radials are distinct enough. This is the case in nearly all our specimens of *Allagecrinus*, both young and old. It may also happen in the young *Encrinus* that one of two arms on the same axillary may remain rudimentary, while the other develops first. The inequality in size of the radials in *Allagecrinus* and of the arms which they bear is even a lower condition than that noticed by Beyrich in the young *Encrinus*. There is no similar stage in the young of recent Crinoids, in which all the radial plates are equal from the first.

The entire absence of orals from the three largest specimens does not necessarily prove that they were not present during life. We imagine that in the subsequent stages to those represented in fig. 7 on Pl. XV. and figs. 8–10 on Pl. XVI., the orals were relatively carried inwards, away from the radials, and separated from them by perisome (just as they are in the Pentacrinoid larva of *Comatula*) when the arms began to appear above the radials. Whether the orals ever separated so as to open the mouth to the exterior, and whether the ring of perisome forming the ventral disk between them and the radials was naked, as in *Rhizocrinus*, or plated, as in *Hyocrinus*, must of course remain undecided. The absence of any distinct anal system in the calyx of the large specimens indicates that the anus was situated in a ventral disk, which, if plated at all, can only have been but lightly so, as in the Ichthyocrinidæ. It is true we have no proof that there were any orals at all in the older specimens; but, judging from the relative sizes and development of the largest examples with oral plates, and the smallest without, we think it scarcely likely that they were entirely unrepresented in the adult. It is obvious that, if they were united to the radials by perisome, whether plated or bare, they would be readily lost under conditions that would have had no destructive effect on younger specimens, in which there was a closer union between the two rings of plates.

Lastly, we may say a few words about the ornament and size of the specimens. In the larger individuals, although visible, the pitted structure is not so decidedly apparent as in many of the smaller and younger ones. For instance take figs. 3 *a* and 10 *a* (Pl. XVI.), as compared with figs. 1 *a*, 2 *a*, and 2 *b* (Pl. XV.). In the former it absolutely amounts to ornamentation.

The diameter of the full-grown calyx varies from about 3 millims. to 5 millims.

3. *On the Relations of the Species.*

Three or four years ago, when our acquaintance with *Allagecrinus* was in a much less advanced state than at present, specimens were forwarded to Prof. L. G. de Koninck of Liége, for his opinion as to their identity. He very kindly referred one of the present writers to the description and figure of the *Poteriocrinus isacobus*, T. and T. Austin [*], as coming nearest in general appearance to the specimens in question. The identity of our little Scotch fossils with this species not being so clear as could be desired, Major Austin, F.G.S., was communicated with for further details of *P. isacobus* than are contained in the description given by himself and his son. Major Austin very kindly replied that his specimens had unfortunately been mislaid. We are therefore unable to institute a close and detailed comparison between *P. isacobus* and our *Allagecrinus*. We propose to call the latter *A. Austinii*, Ether. & Carp., as a slight tribute of respect to Major Austin in connexion with his work on the Carboniferous Crinoidea.

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[*] Mon. Recent and Foss. Crinoidea, p. 74, t. 8. f. 4, *a* & *b*.

According to Messrs. Austin, "the dorso-central and perisomic plates (of *P. isacobus*) appear to agree in number with the typical species" of *Poteriocrinus*. If this be the case, *P. isacobus* is not in the least related to *Allagecrinus*. But in the figure of it given by the Messrs. Austin there is no indication whatever of the presence of two rows of plates below the radials*. We believe the plates which are represented as forming the greater part of the calyx to be the radials, and the ring upon which they rest to consist of five closely united basals, as in our specimens. Above these radials the Messrs. Austin's figure is incomplete: but one portion of it appears to represent the end of a short first brachial which has been displaced; and upon this there seems to have been an elongated axillary brachial, each face of which bore a similarly elongated axillary that supported two arms. Hence there were probably twenty arms.

Mr. Percy Sladen has proposed to establish a new genus, *Dactylocrinus*†, for the fossils described by Miller and the Messrs. Austin respectively under the name *Poteriocrinus tenuis*. He takes that figured by Messrs. Austin as the type of his new genus, and calls it *D. loreus*; while the *Poteriocrinus tenuis*, Miller, becomes the *Dactylocrinus tenuis* of Sladen, who thus continues:—"The *P. isacobus* of Messrs. Austin seems identical with the present species. In any case it is very much nearer than the fossil figured by them as *P. tenuis*." We regret that we are unable to accept this view of

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* The "first series of perisomic plates" of Messrs. Austin are those which one of us has proposed to call "under-basals." This name has been adopted by Messrs. Wachsmuth and Springer and by Prof. Zittel. The "second series of perisomic plates" are the "parabasals" or "subradials" of the old nomenclature, and the "basals" of the more rational modern one. The dorso-central plate described in *Poteriocrinus* by Messrs. Austin is not recognized by other authors as occurring in this genus at all.

† "On the genus *Poteriocrinus* and Allied Forms," Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire, 1877, pp. 245–247.

Mr. Sladen's. Whether the *P. tenuis*, Austin, is identical with *P. tenuis*, Miller, does not concern us now; but underbasals are represented in the type-figures of both authors; while in the Messrs. Austin's figure of *P. isacobus* there is no trace of these plates, and the statement as to their presence is a very guarded one. For the same reason we cannot follow Messrs. Wachsmuth and Springer* in referring *P. isacobus*, Austin, to the sectional group *Scaphiocrinus*, Hall. We believe its calyx to be a simple one, consisting of a monocyclic base supporting five large radials, just as in our own fossil (*Allagecrinus*); and we are disposed to regard the two types as congeneric, but as specifically distinct from one another. In *A. Austinii* some (1 to 4) of the radials may be axillary, bearing arms directly without the intervention of any second or third radials. These arms may have divided (but there is no evidence of their having done so) before the fourth joint above the radials. In *A. isacobus*, on the other hand, there seem to have been but five primary arms, which forked on the third and then again on the fourth joints above the radials. Without a personal examination of the Messrs. Austin's original specimen we are naturally unable to say much about it; but we venture to think we are correct in referring it to a type which is much more closely allied to *Allagecrinus* than to *Poteriocrinus*, *Dactylocrinus*, or *Scaphiocrinus*.

4. *Position of* Allagecrinus *with respect to other Families of Crinoidea.*

If we are right in believing that the various forms figured in Pls. XV. and XVI. are merely different stages in the development of one singularly protean species, *Allagecrinus* must be regarded as a type of singular interest; for although it is a Palæozoic Crinoid, the most advanced individuals are entirely devoid of those characters which are supposed to be specially distinctive of the Tessellata. According to Müller's definition of the "Crinoidea articulata," *Allagecrinus* is as much an articulate Crinoid as *Pentacrinus*. On the other hand, the younger specimens are truly "tessellate," and they retain the peculiarities which are supposed to be eminently characteristic of the Tessellata until they are considerably larger and more strongly built than the largest *Comatula*-larvæ in the "tessellate" stage.

Were we dealing with these specimens only, *Allagecrinus* would find its place without difficulty in the family of the Haplocrinidæ, the special character of which is the presence of a dome of oral plates. But we can find no family, either in the Tessellate or in the Articulate division of the excellent classification of Prof. Zittel*, to which we can refer the larger specimens of *Allagecrinus*. We therefore propose to institute for its reception the family Allagecrinidæ, with a definition essentially the same as that already given for the genus. The inequality of size of the radials, owing to some of them being axillary, is a character which sharply distinguishes *Allagecrinus* from the Encrinidæ, Apiocrinidæ, and Pentacrinidæ, and, in fact, from all the "Articulata," to which division of the Müllerian classification it clearly belongs. It is, however, one of the Palæozoic Crinoids, and, like most members of that group, retains several embryonic features. Hence it adds one more to the many proofs which we have already of the unsatisfactory nature of Müller's definitions of the Articulata and Tessellata.

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* Revision of the Palæocrinoidea, part i. p. 113, extracted from the 'Proceedings of the Philadelphia Academy of Natural Sciences,' Nov. 4, 1879.

5. *Locality and Horizon.*

Allagecrinus Austinii appears to be dispersed generally throughout the shales and some of the limestones of the Scotch Carboniferous system. We are acquainted with its distribution in the east of Scotland much better than in the west. The following may be taken as typical localities:—

No. 16 Mine, Addiewell, near Bathgate, in the decomposed No. 1 main, or Hurlet Limestone; Howood, near Johnston, in shale above the Hurlet Limestone; Catcraig Shore, near Dunbar, and Burlage Quarry, near Dunbar, in shale above the Skateraw Limestone; Carlops Quarry, near Carlops, in shale above the Carlops Limestone; Roscobie, near Dunfermline, in shale above the limestone developed there. The foregoing horizons are all in the Lower Carboniferous Limestone group.

6. *On the Divisions of the Crinoidea. Articulata and Tessellata; Palæocrinoidea and Stomatocrinoidea; Regularia and Irregularia.*

Although Müller's terms Articulata and Tessellata are practically meaningless as regards the Crinoids, they have nevertheless come to be looked upon as representing two very distinct sections of the order, viz. the Mesozoic, Tertiary, and Recent types on the one hand, and the Palæozoic types on the other. We think, however, that the time has come when they may be fitly replaced by other names which are less misleading in their character.

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* Handb. d. Palaontol. Bd. i. pp. 342–346.

According to Müller's original definition[*], the articulate Crinoids are those in which the radii are free down to the base of the calyx. They do not meet laterally; but the intervals between them are filled by perisome continuous with that of the ventral surface of the disk, and either bare or plated. Lütken has pointed out[†] that, according to this definition, the Mesozoic *Apiocrinus* and *Guettardicrinus* cannot be included among the Articulata. In the former the second and third radials are united with their fellows all round the calyx by interradial plates, while in the latter the rays are united as far as the second arm-joints, either directly or by interradial plates. The same is the case in many recent *Comatulæ*. On the other hand the rays of the Palæozoic *Taxocrinus* were just as free as those of *Pentacrinus*; and this genus entirely corresponds to Müller's definition of the Articulata. The same may be said of other so-called "tessellate Palæocrinoids."

An attempt has also been made to separate the Mesozoic Articulata from the Palæozoic Tessellata on the ground that the successive radial plates of the latter are only suturally united, while in the former group they articulate upon one another. Here again, however, *Guettardicrinus* and *Apiocrinus* are tessellate though not Palæozoic Crinoids. Further, in many of the Palæocrinoids the distal faces of the first or second radials are true articular surfaces in which the fossæ for the insertion of muscles and ligaments are much more distinctly marked than in the corresponding joints of many Apiocrinidæ, or even of recent Pentacrinidæ.

In spite of Lütken's well-grounded attack upon the Müllerian classification, it has recently been entirely adopted by Prof. Zittel[‡] on the ground that it "liefert vortrefflich abgegrentzte natürliche Gruppen." We cannot understand, however, how *Cyathocrinus*, *Poteriocrinus*, *Platycrinus*, and *Myrtillocrinus* can find places in a group a leading characteristic of which is that the plates of the calyx are "unbeweglich durch einfache Nähte verbunden." It is obvious from the context that vertical and not horizontal union is meant. The latter occurs in all Crinoids as far as the first radials, and a good deal further in many types; while sutural union in a vertical direction is not exclusively confined to the Palæozoic Crinoids, though it is certainly more common among them than among the younger forms. But at the same time there were several genera (and those by no means the least common) in which the second radials were not only free from their fellows, but articulated to the first radials, in precisely the same manner as the corresponding joints of a *Pentacrinus* or *Comatula.*

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[*] "Ueber den Bau des *Pentacrinus caput-Medusæ*," Abhandl. d. Berlin. Akad. 1843, p. 25 (of separate copy).

[†] "Om Vestindiens Pentacriner med nogle Bemaerkninger om Pentacriner og Sölilier i Almindelighed," Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn, 1864, no. 13–16, pp. 220 *seq.*

[‡] *Op. cit.* pp. 342 and 345.

Other genera, however, are characterized by a peculiarity which is only met with among the Palæocrinoidea, viz. the absence of any distinct articular surface on the distal faces of the first radials, which are not perforated by canals for the axial cords of the rays. The presence of these canals is mentioned by Zittel among the characters of the Mesozoic and younger Crinoids; but their absence is not distinctive of the Palæocrinoids, as they exist in *Platycrinus* and in all the forms with true articular facets on the first radials.

There are several Palæozoic types, however, in which the second radials were in contact with the first by semicircular or horseshoe-shaped surfaces, with or without notches for the reception of the axial cords at the bottom of the concavity. This, though a permanent condition in some Palæocrinoids, is a transitory one in the young *Comatula*, and, as seen above, in the young *Allagecrinus*; and as none of the Neocrinoidea (if we may so call them), with the doubtful exception of *Comaster*, Goldfuss *, retains this peculiarity when mature, it is, as far as it goes, a good general character for separating the younger from the older Crinoids.

Another and a better distinction between them is one on which considerable stress has been recently laid by Messrs. Wachsmuth and Springer †, who believe that the mouth was internal in most Palæozoic Crinoids, if not in all of them; while it is external and suprategminal in the recent forms, for which they propose the general term Stomatocrinoidea.

That the mouth was internal in the Actinocrinidæ we have, of course, not the smallest doubt; but we would point out that the "vault" of this family, closing in the mouth and all the covered ambulacra of the body, is a very different structure from the six "apical dome-plates" of the Cyathocrinidæ and Ichthyocrinidæ, which merely close the peristome and leave the plated ambulacra as much external as those of any recent Crinoid. We see no reason to believe that the plates bordering these ambulacra were not movable during life, like the similar ones on the ambulacra of the arms, so that the food-grooves were completely open to the exterior. In fact Wachsmuth[*] admits that "this might possibly have been the case in *Cyathocrinus iowensis*; but I even doubt it here, as the corresponding plates in other closely-related species, though arranged upon the same fundamental plan, present rather an aspect of true vault-pieces." Whatever may have been the case in the Cyathocrinidæ, we believe that the ventral disk of the Ichthyocrinidæ, which was composed of "a more or less soft or scaly integument yielding to motion in the body and arms," was essentially like that of a recent Crinoid with movable plates bordering the ambulacra and an irregular pavement in the interradial areas. We cannot therefore regard *all* the Palæocrinoids as having been without external food-grooves, as is supposed by Wachsmuth and Springer; and we think it also quite possible that the apical dome-plates of the Cyathocrinidæ and Ichthyocrinidæ were movable during life, so that the mouth was open to the exterior. Hence we do not attach quite so much importance to these two characters as do Wachsmuth and Springer. But we regard the *presence* of the apical dome-plates or of a true vault, and not the condition of the mouth and food-grooves, as an important distinction between the older and the younger Crinoids. It is certainly a more constant one than the absence of axial canals in the radials, though not altogether universal.

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* Linnean Society's Journal, Zoology, vol. xiii. pp. 454-456.

† *Op. cit.* pp. 6, 30. See also "Notes on the Internal and External Structure of Palæozoic Crinoids," by Charles Wachsmuth ('American Journal of Science and Arts,' 1877, vol. xiv. pp. 117-127 and 181-190).

Probably the most constant difference between the Palæozoic and the younger Crinoids is one to which we do not think attention has yet been drawn. In almost all the Mesozoic and recent Crinoids the calyx is perfectly regular and symmetrical all round[†]. There are five equal and similar basals, upon which rest five equal and similar radials; and each of these is in close lateral union with its immediate neighbours without the intervention of any interradial pieces at all[‡]. Should there be any interradials in the calyx, as between adjacent second or third radials, they are not limited to any special side of the calyx, but are equally distributed all round it, as in *Guettardicrinus* and *Apiocrinus*. Lastly, if the rays divide, it is always the third radial that is the axillary joint.

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[*] Palæozoic Crinoids, p. 184.

[†] The distortion of the calyx in the Eugeniacrinidæ may be left out of consideration for the present.

[‡] The partial freedom of the first radials from one another in *Bathycrinus* and *Pentacrinus subangularis* does not affect the question under discussion, owing to the absence of interradials in these genera.

Now in the Palæozoic Crinoids the symmetry of the calyx is always disturbed by the presence of an anal or azygos side. This may be indicated simply by the presence of an anal opening, which notches one of the oral plates, as in *Phimocrinus*, *Haplocrinus*, &c., or by the presence of a single anal plate, as in *Belemnocrinus*, which in other respects has such a close resemblance to the recent *Rhizocrinus*, or more commonly by the fact that one of the basals and two of the radials differ from their fellows in size and shape so as to give room for the system of anal plates which separates two of the rays, or in some similar manner.

Even in cases where the radials are closely united all round and the general contour of the calyx is perfectly regular, a want of symmetry is indicated by the inequality in the numbers of basal and radial plates. This is the case, for example, in *Eucalyptocrinus*, which has five radials but only four basals.

Lastly, in those Palæozoic Crinoids which have divided rays the position of the axillary joint is by no means so fixed as in the younger types. The rays may fork on the first radial, as in *Allagecrinus*; or the axillary may be as many as six joints beyond it, as in *Poteriocrinus radiatus*, or in any intermediate position.

Taking all the above facts into consideration, we are inclined to think that the Palæocrinoids do constitute a group that is distinguished from the more modern types by an assemblage of very definite characters, perhaps the most constant of which is the distinction between the perfectly symmetrical calyx of the Mesozoic and recent forms, and the more or less irregular one of the Palæocrinoids. We suggest therefore that the two groups should be distinguished as the Palæocrinoidea (Wachsmuth) and Neocrinoidea (nob.), or as Irregularia and Regularia. The old terms Articulata and Tessellata are meaningless, as we have shown above, while the name "Stomatocrinoidea," proposed by Wachsmuth, is long and cumbersome; and we are by no means sure that some of the Palæocrinoids did not have an external oral opening.

Whatever name be adopted for the Palæozoic Crinoids, they are of the highest interest morphologically, owing to their presenting so many embryonic characters. These may be briefly summarized as follows:—

1. The great development of the orals, which sometimes form a closed pyramid.
2. The frequent presence of a more or less perfect vault

(in the absence of a closed oral pyramid), which covers in either the whole of the ventral side or only the peristome.

3. The want of symmetry, indicated by the presence between two rays of one or more special "anal plates."

4. The great development of the calyx as compared with that of the arms.

5. The frequent absence of a distinct articulation between the first and second radials, and of axial canals within the joints of the rays and arms.

EXPLANATION OF THE PLATES.

Plate XV.

Adult specimens.

Fig. 1. Nine-armed calyx with two brachials. Carlops Quarry, near Peebles. *a*, side view, showing the small radial, which bears one arm only; *b*, view of the calyx from above, showing the articular faces of the radials.

Fig. 2. Calyx and lower brachials of another nine-armed example, the most complete yet found. Carlops Quarry. *a* and *b*, side views, the former showing the single one-armed radial plate; *c*, ventral aspect of the same specimen, showing the second and third brachials or arm-joints of three arms.

Fig. 3. Projection of the calyx and lower brachials of the original of fig. 2.

Fig. 4. The basal cup as seen from above; the sutures are quite obliterated. Carlops Quarry.

Fig. 5. Terminal face of a stem-joint, showing rim-like margin, small canal, and central granulation. Carlops Quarry.

Fig. 6. Calyx with only three axillary radials and one of the first brachials still preserved. Carlops Quarry. *a*, ventral aspect of the calyx; *b*, side view, showing the two adjacent simple radials and one first brachial.

Intermediate specimen.

Fig. 7. Calyx and upper stem-joints of an irregular example, with small orals and unequally-developed radials. Near Carluke. *a*, from the side; *b*, from above; the radial on the right bears a very rudimentary brachial.

N.B.—The figures represent the specimens as magnified nine times.

Plate XVI.

Young specimens.

Fig. 1. Calyx of a very young individual, with unequally-developed radials and depressed oral pyramid. Catcraig, near Dunbar. × 25. *a*, from the side; *b*, from above.

Fig. 2. Calyx of another very young specimen, with a large dome of oral plates and very small arm-openings. Whitebaulks, near Linlithgow. × 25. *a*, from the side; *b*, from above.

Fig. 3. Calyx of a somewhat older example, with a depressed oral pyramid; three of the radials have distinct arm-facets. No. 16 Mine, Addiewell. × 25. *a*, from the side; *b*, from above.

Fig. 4. Calyx of a more advanced individual, with a higher and deeply-grooved oral pyramid and more marked arm-facets. Catcraig, near Dunbar. × 23.

Fig. 5. Calyx of a similar specimen, with equally developed radials and a single oral tubercle; the five grooves separating the orals are well shown. Burlage Quarry, near Dunbar. × 23.

Fig. 6. Calyx of a similar example, in which the centre of the oral pyramid has been broken away, leaving a rounded hiatus; portions of the grooves again visible.

Fig. 7. Calyx of a larger specimen, with a low deeply-grooved oral pyramid and large arm-openings. Catcraig, near Dunbar. × 24. *a*, from the side; *b*, from above.

Fig. 8. Three views of the calyx of a still more advanced individual, with unequally developed radials and a relatively small oral pyramid. Burlage Quarry, near Dunbar. × 26. *a*, from the side, showing a small radial; *b*, from the side, showing the large axillary radial; *c*, from above, showing the reduced condition of the orals.

Fig. 9. Calyx of a specimen in which three radials have distinct articular facets, whilst another has no facet, even of the simplest kind, and there is only an imperfect one on the fifth. Howood, near Johnstone. × 24. *a*, from the side; *b*, from above.

Fig. 10. Calyx of a much pitted specimen, with a small and low oral pyramid and well-marked articular facets on all the radials. Carlops Quarry, near Carlops. × 25. *a*, from the side; *b*, from above.

XXVIII.—*Description of a new Longicorn Beetle from Java.*

By W. L. Distant.

This fine Coleopteron was represented by a single example only in an entomological collection made by my friend Baron A. von Hügel in the neighbourhood of Kederi, Java. Mr. C. O. Waterhouse of the British Museum, to whom I exhibited it, and who kindly took some trouble with me in ascertaining it be an undescribed form, is desirous of figuring the same in his illustrated work, 'Aid to the Identification of Insects,' and has requested me to describe it forthwith.

Pachyteria Hügeli, n. sp.

Glabrate; cyaneous; head, first to seventh joints of antennæ, a little less than basal half of elytra, and legs ochraceous; four apical joints of antennæ dull black; eyes cyaneous and glabrate. Lateral margins of body beneath faintly clothed with greyish pubescence.

The head has a distinct, central, longitudinal incision on the vertex, with the base above somewhat faintly obscured with cyaneous. Thorax wider than the head; lateral margins subampliated, rounded, and transversely sulcate; base and apex constricted and transversely sulcate; disk finely and obscurely punctate, with a faint central raised longitudinal line. Scutellum finely punctate, with a central longitudinal impression. Elytra obscurely punctate, with eight fine longitudinal striæ—two subsutural, four on disk, and two near margins; these striæ are most distinct on the basal ochraceous portion, and become more evanescent and obscure towards apex. Prosternum transversely striate and very sparingly punctate; metasternum coarsely punctate.

Long. 42 millims.

This species is allied to *P. bicolor*, Parry, but differs by the much more rounded sides of the thorax, the legs entirely ochraceous, &c.

XXIX.—*New Neotropical Curculionidæ*.—Part V.

By Francis P. Pascoe, F.L.S. &c.

LEPTOPINÆ.

Rhigus vespertilio.
Cydianirus ornatus.
Dacnirus, n. g.
—— flexuosus.

HYLOBIINÆ.

Hypnideus, n. g.
—— circumductus.

ERIRHININÆ.

Ochetina, n. g.
—— uniformis.

CHOLINÆ.

Dionychus conciliatus.

CRYPTORHYNCHINÆ.

Conotrachelus eximius.
Cyphorhynchus rugosus.
—— scapulatus.
Edesius, n. g.
—— obesus.
Barisses, n. g.
—— rufipennis.
Analcis fasciatus
—— striatus.

PYROPINÆ.

Pyropus pusillus.

CALANDRINÆ.

Ithaura nitida.

Rhigus vespertilio.

R. oblongus, compressus, dense griseo-squamosus, utrinque vitta umbrina irregulari notatus; prothorace angusto, tuberculo laterali instructo; elytris singulatim tuberculatis, apicibus productis. Long. 7 lin.

Hab. Brazil.

Oblong, compressed posteriorly, almost wholly covered with greyish scales, the prothorax and elytra with an irregular umber-brown stripe on each side; rostrum very broadly dilated at the tip, three grooves in front and a curved deeper one on each side; antennæ scaly and setose; scape rather long; second joint of the funicle a little longer than the first, the next four turbinate, the last longer than any of the preceding four; club elliptic; prothorax narrowed, longer than broad, the disk unequal, the sides deeply corrugated and having an obtuse tubercle just before the middle, ocular lobes very prominent; scutellum raised, small, rounded; elytra much compressed posteriorly, abruptly declivous at the apex, above the slight preapical callus a stout conical tubercle, a smaller one on each side of the disk nearer the shoulder, the latter prolonged into a horizontal conical tubercle; body beneath and legs with closely placed scales of grey speckled with brown.

A very distinct species; an example in the British Museum bears Dupont's catalogue name here adopted.

Cydianirus ornatus.

C. late ovatus, squamulis flavis sat dense vestitus, supra nigro-maculatus; prothorace integro, leviter punctato; elytris breviusculis, subtiliter striato-punctatis. Long. 4½ lin.

Hab. Brazil.

Broadly ovate, almost wholly covered with rather closely set yellow scales, above with black spots; head convex in front, black posteriorly; rostrum triangularly flattened anteriorly; antennæ with yellow scales at the base, gradually greyish and pilose towards the tip; funicle with the second joint nearly twice as long as the first; club elongate, slender, fusiform; prothorax transverse, slightly contracted at the base, rounded at the sides, four black spots on the disk and one on each side; scutellum oblong; elytra rather short, much broader at the base than the prothorax, striate-punctate, punctures masked by the scales, each elytron with thirteen round very distinct black spots; body beneath and legs closely covered with pale yellow and saffron-coloured scales; first abdominal suture straight.

This species, of which I have only seen the one example in my own collection, bears a striking resemblance to the Madagascar *Stigmatrachelus ornatus*, but differs entirely in the rostrum, antennæ, &c.

DACNIRUS.

Antennæ scapo brevissimo. *Prothorax* lobis ocularibus obsoletis. *Cætera* ut in *Rhigo*.

The sole exponent of this genus at present has a very different aspect from any thing in *Rhigus* or in *Cydianirus*; but to the latter it might perhaps have been referred but for the strongly mucronate anterior tibiæ, which furnish the principal, if not the only, character differentiating these two genera. The scape does not extend beyond the short, almost transverse, portion of the scrobe.

Dacnirus flexuosus.

D. oblongus, flavo-squamosus, prothorace scutelloque fusco-brunneis, illo confertim granulato-punctato; elytris leviter striato-punctatis, plagis duabus sinuatis transversim notatis. Long. 3½ lin.

Hab. Brazil.

Oblong, mostly covered with sulphur-yellow scales; head in front scaleless, brown, closely punctured; rostrum slightly compressed, strongly curved anteriorly and broadly grooved, densely covered with yellow scales; antennæ with setulose scales at the base; first joint of the funicle short, second twice as long; club elongate, ovate; prothorax about equal in length and breadth, scaleless, chocolate-brown, coarsely and closely granulate-punctate, the sides rounded; scutellum oblong, brown; elytra at the base nearly twice as broad as the prothorax, the shoulders slightly prominent, narrowed at the apex, striate-punctate, two brown, very irregular, flexuous or sinuate transverse patches at equal distances from each other and from the base and apex, but not extending to the outer margin; metasternum rather short; first abdominal suture curved.

I owe my specimen of this species to Mr. Fry, who has taken it near Rio.

HYPNIDEUS.

Rostrum breve, crassum; *scrobes* obliquæ, antemedianæ. *Antennæ* breviusculæ; *clava* a funiculo sat distincta. *Oculi* laterales, ovati, infra subacuminati. *Prothorax* basi rectus. *Elytra* demissa, humeris obliquis, ad latera tuberculo instructa. *Femora* valida, dente parvo instructa; *tibiæ* sulcatæ, intus bisinuatæ; *tarsi* normales; *ungues* connati. *Abdomen* sutura prima arcuata.

Allied to *Sternuchus*, but differentiated by the depressed elytra not rising above the level of the prothorax. The club of the antennæ is also clearly marked off from the last joint of the funicle. One of my specimens is labelled *Clinorhynchus heilipoides*, Jek.

Hypnideus circumductus.

H. subellipticus, niger, vitta lata dorsali utrinque (postice ad suturam ducta) et plaga apicali albo-squamosis ornatus. Long. 6 lin.

Hab. Para.

Subelliptic or somewhat ovate, glossy black, a broad stripe of white scales beginning behind the eye and continued on the back on each side of the prothorax and elytra to near the preapical callus, joining its fellow at the sutura, at the apex a patch of white scales; head and basal half of the rostrum coarsely punctured; antennæ pitchy, first joint of the funicle as long as the three next together, the terminal joints slightly setulose, club densely tomentose; prothorax slightly broader at the base than long, the apex tubular, the sides rounded, closely punctured, an oblong cavity behind the apex; scutellum subcordate; elytra broadest behind the base, abruptly declivous behind, coarsely seriate-punctate, the intervals transversely ridged, preapical callus not prominent, apex of each elytron rounded; body beneath and legs with small scattered setulæ.

OCHETINA.

Rostrum gracile, arcuatum; *scrobes* premedianæ, subreotæ. *Antennæ* tenues; *funiculus* sexarticulatus. *Oculi* reniformes, transversi, grosse granulati. *Prothorax* transversus, basi rotundatus. *Scutellum* invisum. *Elytra* breviuscula, humeris prominulis. *Abdomen* segmentis tertio quartoque brevissimis, segmento secundo ad latera angulo producto. *Femora* subclavata, mutica; *tibiæ* perparum arcuatæ, intus sulcatæ, apice mucronatæ; *tarsi* elongati, lineares, articulo penultimo integro; *ungues* liberi.

In its linear tarsi this genus agrees with *Bagous*; but its long slender rostrum and entire propectus will at once differentiate it. The peculiar structure of the tibiæ (grooved for the reception of the tarsi in repose) is probably unique in this family.

Ochetina uniformis.

O. ovata, fusca, squamositate grisea fere omnino tecta; rostro castaneo, denudato. Long. 2¼ lin.

Hab. Amazon (Ega?).

Ovate, dark brown, almost everywhere covered with a greyish squamosity or crust; rostrum chestnut, shining, much longer than the prothorax and well curved; antennæ ferruginous; two basal joints of the funicle longer than the rest together, the first shorter and stouter than the second; club elliptical; prothorax rounded at the sides and very slightly at the base, irregularly punctured; scutellum not apparent; elytra a little broader than the prothorax, striate-punctate, the apex narrowly rounded; tibiæ with a broad groove, clothed with short hairs, passing to the inner margin, and receiving the tarsi in repose; sterna and abdomen rather remotely punctured.

Dionychus conciliatus.

D. oblongo-obovatus, niger, supra griseo-squamosus; elytris singulatim lineis quinque elevatis, nitide nigris, denudatis, aliis quatuor leviter granulatis instructis. Long. 8 lin.

Hab. Brazil.

Oblong-obovate, black, with pale greyish scales; rostrum as long as the prothorax, carinate, and closely punctured throughout; antennæ pitchy, setulose; first joint of the funicle as long as the three following together; prothorax slightly broader than long, finely granulate, the intervals covered with minute greyish scales; scutellum slightly transverse, convex, finely punctured; elytra gradually narrowing from the base, each with five lines, smooth, glossy black, densely scaly between, but with a finely granulated line partially dividing the scaly portion; body beneath and legs furnished with greyish setulæ, on the latter more dispersed.

Allied to *D. parallelogrammus*, but differing principally in the elytra, which have, including the outer margin, only five raised lines on each instead of ten; the granulated lines, confined to the basal half of the elytra, may be considered the representatives of the uniform lines present in the former species.

Conotrachelus eximius.

C. ovatus, nitide fuscus, supra lineis annulisque silaceo-squamosis ornatus; elytris modice convexis, sat fortiter striato-punctatis; femoribus (basi apiceque nigris exceptis) luteis. Long. 4 lin.

Hab. Sarayacu, Macas.

Ovate, dark glossy brown, with very distinct lines and rings of silaceous scales; rostrum much longer than the prothorax, curved, with two punctured grooves on each side; scrobes commencing at about three fourths from the base; antennæ ferruginous; funicle with the three basal joints elongate, second longest, the rest turbinate; club ovate, distinctly four-jointed; eyes nearly meeting beneath; prothorax narrowed anteriorly, the sides of the posterior half parallel, irregularly and closely punctured, a looped line posteriorly prolonged into a single one on each side; scutellum oblong, elevated; elytra nearly twice as broad as the prothorax at the base, seriate-punctate, punctures rather coarse, an irregular ring on each shoulder, another close to the apex, between the two and behind the middle a slightly flexuous linear band; mesosternum elevated, triangular; second abdominal segment only a little longer than the third or fourth, suture separating it from the first slightly arched; legs elongate; femora glossy luteous yellow, base and apex black; tibiæ and tarsi blackish, with a dull luteous tint.

A very distinct species, in its coloration resembling some of the *Hilipoda* from the same locality. In any future dismemberment of this group it would probably be found to be congeneric with *C. corallifer.*

Cyphorhynchus rugosus.

C. ovatus, fuscus, squamositate grisea adspersus, supra tuberculatus; prothorace elytrisque basi linea brevi obliqua alba ornatis, illo apice valde producto. Long. 3½ lin.

Hab. Ega.

Ovate, dark brown, with a sparse greyish squamosity; rostrum much shorter than the prothorax, constricted at the base, at first compressed, but becoming broader to the tip; prothorax very irregular, a narrow slightly emarginate lobe projecting beyond the head, its centre carinate, the disk with two approximate mamilliform tubercles in the middle; scutellum oblong; elytra subcordiform, much broader at the base than the prothorax, shoulders oblique, rather abruptly declivous posteriorly, the back and sides with tubercles varying in size, the largest much compressed, the intervals with coarsely-impressed punctures, at the base, on each side of the scutellum, a short oblique line of white scales continuous with a duller line crossing the posterior angle of the prothorax, the apex with a round yellowish-white spot on each side; mesosternum moderately elevated; abdomen dark brown, opaque; tibiæ much compressed.

Cyphorhynchus was a genus originally propounded by Schonherr, but which he afterwards merged into *Conotrachelus,* from which, in my opinion, it essentially differs in its deformed or misshapen rostrum. *C. squalidus,* Boh., and *C. singularis,* Gyll., are evidently strangers to the genus.

Cyphorhynchus scapulatus.

C. oblongo-ovatus, fuscus, squamositate obscura adspersus, supra minus tuberculatus: prothorace apice elevato, vix producto; elytris ad humeros linea arcuata albido-squamosa notatis. Long. 3¼ lin.

Hab. Para.

Oblong-oval, dark brown, with a sparse dull squamosity; rostrum compressed throughout, irregularly carinate; antennæ pale ferruginous; prothorax narrow, closely punctured, the apex elevated and slightly emarginate above, somewhat depressed or hollowed anteriorly, two conical approximate tubercles in the middle; scutellum ovate; elytra much broader than the prothorax at the base, the sides subparallel, shoulders shortly rounded, a line of white scales at the base, curving round the shoulders, and nearly meeting its fellow at the suture behind the scutellum, tubercles fewer and smaller, with punctures in the intervals; body beneath dark brown; mesosternum elevated and prominent; tibiæ moderately compressed.

Differs from the preceding in the prothorax not prolonged at the apex, the oblong elytra, and the more slender and less compressed tibiæ.

EDESIUS.

Rostrum validum, basi subito arcuatum; *scrobes* infra rostrum cito desinentes. *Oculi* laterales. *Prothorax* parvus, lobis ocularibus apiceque productis, basi bisinuatus. *Elytra* ampla, in medio elevata, lateribus carinatis. *Pectus* profunde canaliculatum. *Coxæ* anticæ basi contiguæ. *Mesosternum* depressum; *femora* infra dentata; *tibiæ* arcuatæ, apice uncinatæ; *ungues* apice fissiles.

This genus would probably be referable to *Conotrachelus* if it did not constitute, as Lacordaire has observed, "not one but many genera." Schönherr gives as its type *C. diaconitus*, and as one of its characters, a "long, linear, and often filiform" rostrum, only the base of which can be received in the pectoral canal, which is bounded behind by the anterior coxæ. In this genus, owing to its comparative shortness and the depressed mesosternum, the rostrum can be retained to its full extent. The species described below has, at the first glance, much the appearance of *Cionus thapsus*.

Edesius obesus.

E. breviter ovatus, squamositate albida griseo-varia indutus, supra inæqualis, tuberculatus. Long. 3½ lin.

Hab. Pará.

Shortly ovate, covered with a whitish squamosity, varied or clouded with greyish, above irregular and tuberculate; rostrum ferruginous, with a carina on its lower third, scrobes commencing near the apex; antennæ pale ferruginous, the two basal joints of the funicle equal and elongate, the rest shortly obconic; club ovate, distinctly jointed; eyes in repose covered by the ocular lobes; prothorax transversely conic, gibbous in the middle, hollowed out at the sides and base; scutellum oblong, elevated; elytra twice as broad at the base as the prothorax, very convex, shoulders prominent, apex rounded, indistinctly subseriate-punctate, the third interstice with three tubercles, the middle one greatly elevated and longitudinally compressed, the fifth interstice with three smaller tubercles, two of which are basal, the side with a carina extending from the shoulder to near the apex; sterna and legs closely covered with greyish scales; abdomen black, with scattered punctures, each bearing a scale.

BARISSES.

Rostrum breve, validum; *scrobes* obliquæ, infra rostrum cito desinentes. *Oculi* majusculi, rotundati, fortiter granulati. *Antennæ* medianæ; *funiculus* septemarticulatus. *Prothorax* transversus, lobis ocularibus prominulis. *Scutellum* majusculum. *Elytra* breviuscula, convexa. *Rima* pectoralis inter coxas intermedias terminata, apice elevata. *Abdomen* segmentis tribus intermediis æqualibus, sutura prima recta. *Femora* sublinearia, subtus sulcata et dente armata; *tibiæ* compressæ, extus recte carinatæ, apice mucronatæ; *ungues* liberi.

The short rostrum, round eyes, large scutellum, sulcated femora, and tibiæ with a straight carina or shortly-produced ridge along the outer margin, are characters which will at once distinguish this genus from *Pseudomus*, to which, however, it cannot be considered a very close ally.

Barisses rufipennis.

B. breviter ovatus, castaneus, elytris valde convexis, rufescentibus. Long. 3½ lin.

Hab. Parana.

Shortly ovate, chestnut-brown, the elytra rufescent (or, under a strong lens, inclining to ferruginous), with sparse pale silaceous hairs; rostrum shorter than the head, much stouter towards the apex, broad and very slightly convex in front, and sparingly punctured; antennæ pale ferruginous, two basal joints of the funicle equal in length, the last closely attached to the club; eyes approximate; prothorax shortly conic, slightly rounded at the sides, deeply pitted with oblong, mostly coalescing punctures, the intervals forming narrow, longitudinal, short, glossy ridges; scutellum round; elytra oblong-cordate, much broader than the prothorax, and very convex, deeply striate-punctate, the interstices glossy and somewhat rugose; body beneath and legs glossy yellowish ferruginous, with approximate punctures, each bearing a pale silaceous hair, the punctures on the legs more elongate.

Analcis fasciatus.

A. sat anguste ellipticus, nitide niger, fasciis fulvo-squamosis ornatus; prothorace latitudine longitudini æquali; elytris seriatim punctatis. Long. 2 lin.

Hab. Amazon (Ega ?).

Rather narrowly elliptical, glossy black, banded with fulvous scales; rostrum shorter than the head, stout, punctured; antennæ ferruginous, funicle short and stout, club small; prothorax not longer than broad, obsoletely punctured, band before the middle of transversely-set scales bounded on each side by a stripe, curved downwards, of similar scales; scutellum moderately large; elytra broader at the base, normally convex, seriate-punctate, punctures small and remote, on each elytron four bands (not meeting at the suture), the basal not extending beyond the shoulders; body beneath and legs punctured, each puncture bearing a small white scale.

Analcis has hitherto been confined to North America. Dr. Leconte records seven species; but he adopts Say's name of *Tyloderma* (it has no such character) in strict conformity (much to the detriment of science) with those who insist upon an *absolute* rule of priority. Schönherr's name *Analcis* was published in 1837, and has been in use ever since; Say's name appeared in 1831, in what work is not mentioned.

Analcis striatus.

A. anguste ellipticus, æneus, squamulis elongatis albis parcissimo adspersus; prothorace latitudine longiore; elytris fortiter striatis. Long. 2¼ lin.

Hab. Minas Geraes.

Narrow elliptic, brassy brown, nearly scaleless; rostrum not longer than the head, finely punctured; antennæ ferruginous, second and third joints of the funicle nearly equal in length, the first longer than either; club broadly ovate; prothorax longer than broad, obsoletely punctured; scutellum triangular; elytra rather elongate, strongly striate-punctate, the punctures large and quadrangular; metasternum and first abdominal segment coarsely punctured; legs pitchy.

The absence of squamose bands and the striated elytra will at once distinguish this species.

Pyropus pusillus.

P. breviter ovatus, glaber, cyaneus, nitidus, antennis piceis; scutello subtriangulari, nigro. Long. 1 lin.

Hab. Jamaica.

Shortly ovate, smooth, blue or inclining to violet, shining; antennæ pitchy. Allied to *P. sapphirinus*, but differs in its much smaller size, wholly blue colour (except the antennæ), prothorax comparatively more strongly punctured, and shorter scutellum.

Gyllenhal, in his description of the species, the only one then known, says "Scutellum nullum;" but in characterizing the genus he rightly says "Scutellum minutum, punctiforme."

Ithaura nitida.

I. oblongo-elliptica, vix depressa, silaceo-brunnea, nitida; rostro cum capite inter oculos carinato et rude punctato. Long. 3¼ lin.

Hab. Parana.

Oblong elliptic, scarcely depressed, glossy yellowish brown; rostrum shorter than the prothorax, a central carina at its base, commencing between the eyes, with three rows of coarse punctures on each side; antennæ short and stout, slightly pubescent; prothorax longer than broad, abruptly constricted at the apex, remotely and rather finely punctured; scutellum small, somewhat transverse, rounded; elytra delicately striate, the striæ marked with coarse oblong punctures, the alternate interstices raised posteriorly; tibiæ short, seriately setulose; tarsi very small.

The type species of this genus is figured and described in the 'Journal of the Linnean Society,' vol. xi. pl. vi. fig. 2, pp. 215, 216. It is a longer and proportionally narrower insect than this species, differently sculptured, and with a rather dull varnished appearance. The genus is allied to *Aphyoda*, another singular form, and both approximating to the group of which our too well-known *Calandra granaria* is an example; but the head deeply constricted behind the eyes, and the small portion which lies between them, seem alone to warrant their separation as a group apart.

Of some of the species described in these papers coloured figures will be given in Mr. C. Waterhouse's 'Aid to the Identification of Insects.'

XXX.—*On the Kunker Formation of the Alluvium in India compared with the Flint Formation in the Chalk of England.* By H. J. Carter, F.R.S. &c.

Perhaps De la Beche and Elie de Beaumont were the first to insist more especially on the necessity of studying the present to interpret the past in geology—thus avoiding all theory and speculation in establishing facts which, if pursued truthfully, offer great attraction to the scientific mind, but, if otherwise, cannot fail to do the opposite.

Under such views I venture to compare the formation of the nodular and so-called "sheet" kunker of India with that of flints and chert in the Upper Chalk and Greensand of England respectively—bearing in mind that the former is in alluvial deposits and *calcareous*, and that the latter are parts of the Cretaceous system and *siliceous*.

Among the "Post-tertiary and Recent Formations" of India mentioned in Medlicott and Blanford's 'Manual of the Geology of India,' 1879 (vol. i. p. 371), it is stated:—that kunker is "concretionary carbonate of lime," most commonly presenting itself "in nodules of an irregular shape from half an inch to three or four inches in diameter," as well as in "thick beds, in the alluvium," . . . . "often filling cracks in the latter and the older rocks" beneath (p. 381); that "at Bombay the alluvial deposits consist of blue and yellowish-brown clay," of which the former "contains small grains and nodules of kunker," while the latter "abounds with it in large masses" (p. 424); and, lastly, that the regur, or black soil of India generally, which is argillaceous, usually, when more than about 6 to 10 feet deep, passing downwards into brown clay, also "abounds in kunker" (p. 431).

The late Captain Newbold observes of the regur, that "from Courtney to Yailbenchi, four miles, the plain continues as before, covered with a substratum of regur, or black cotton-soil of India, to a depth of 1 to 18 feet, in many places resting immediately on gneiss and granite, in others on an intervening bed of calcareous deposit somewhat resembling the travertin of Italy, though more nodular, and called by the natives 'kunker.' It is burnt by them for lime. Like rows of flints in chalk it is seen also in the lower layers of the regur often with sharp projecting spiculæ of carbonate of lime, which would have been broken off had the nodules been drift-pebbles." ('Notes, principally Geological, on the Tract between Bellary and Bijapore,' by Captain Newbold, F.R.S. &c., Madras Army. Reprinted in Carter's 'Geological Papers on Western India,' 1857, p. 308.)

In the same compilation, under the head of "Kunker," in the index (p. 780), will be found references to all that had been stated of kunker up to that time, viz. 1857; while at pp. 159 and 700 are my own accounts respectively of the kunker formation as it occurs at Bombay and over India generally. They are as follows:—"There is a feature of this clay ('Geology of the Island of Bombay,' 1850), however, which is very remarkable, viz. the kunker formation. This, which consists of concretionary limestone, occurs massive or scattered throughout the clay in small isolated portions. In its massive state it is found in large boulders or in continuous tracts, reposing on the freshwater strata or igneous rocks beneath, and in this state is compact and cavernous, enclosing portions of the clay in its cavities &c. in which it has been formed; or as a conglomerate with sandy or gravelly detritus from the igneous rocks, and the remains of small shells, assimilating it to the sandy beaches [littoral concrete]. Those portions which are scattered throughout the clay are more or less round, like *Septaria*; very uniform in structure, and some so pure that they wholly dissolve in nitric acid. They are generally of a blue colour, but sometimes quite white and identical with chalk. Like *Septaria*, also, they are irregular and almost invariably envelope the remains of some organic matter, such as pieces of reed, wood, the remnants of crab-shells, &c., which are very frequently removed, and leave nothing but their moulds in the centre of the concretions. This substance also accumulates in the interior of shells and almost always fills the cavities of pholadine tubes which have been formed in the clay. It does not always, however, envelope organic remains, but may be seen appended to them in a globular form—to the pincher of a crab-claw, for instance. Occasionally it may be seen, in a vertical section of the clay, in the state of a number of isolated particles or concretionary nuclei round a piece of wood, as if in process of forming a nodule, not by successive layers, but by the increase of substance round different centres."

As much the same statement is given in my 'Summary of the Geology of India' (1858), I need not repeat it here, nor add more than that the surface of the regur generally is overspread with the nodules of kunker which have been weathered out of it, and that, in a great many parts of the Southern Mahratta country (according to Lieut. Aytoun, Geol. Papers, *op. cit.* p. 389), it occurs continuously at the bottom of the regur, in the form of a conglomerate, which he terms "*sheet* kunker."

Although remnants of organic matter in the kunker do not appear to have become fossilized generally, yet Captain W. T. Nicholls, formerly of the 24th Regiment, Madras Native Infantry, who was a *very* good and accurate observer, states with reference to some on the black soil, which he discovered in Central India near Narrainpoor, about 17 miles south-east of Saugor, as follows, viz. :—" I found fossils in three spots on the surface of the regur soil. At the first spot, fragments of dicotyledonous wood with a fragment of palm, one fragment of fossil bone, and a fossil ? palm-seed, converted into tuffaceous lime [kunker]. At the second spot, fragments of large bones strewed on the surface of the black regur soil, and one or two fragments of fossil wood, together with irregular flat pieces of tuffaceous limestone loose on the surface. These bones are silicified." . . . "The third spot is about 150 yards from the last; and here I found dicotyledonous wood only. . . . They lie on the black regur soil; and I see nowhere else that they could have come from but out of it" (Geol. Papers, *op. cit.* p. 766). It would therefore appear that, in some parts, the organic remains of the regur have become transformed into kunker, which, under the circumstances, does not appear extraordinary.

Thus we have the kunker lying in loose nodules on the surface, occurring in seams like flints; appended to or enclosing organic remains, or in the form of layers embodying heterogeneous material; sometimes transforming the organic remains of the regur into its own substance. Hence, if we were to substitute the terms "flint" and "chert" for the nodular and so-called "sheet" kunker, the description would apply equally well, *mutatis mutandis*, to the Upper Chalk and Greensand.

Now, as regards the flints and chert, I happen to be living on the New Red Sandstone (at Budleigh-Salterton, Devon) where the surface is covered generally with the silicified débris of the Upper Chalk and Greensand which once overlay it in their integrity; and I observe that, together with other fossils, there are a great number of sponges, especially belonging to the Lithistina (Prof. Zittel's "Megamorina" and "Tetracladina"). Taking one of these I find :—1st, that a flint may be appended to it; 2ndly, that the flint may enclose it; 3rdly, that the flint may have so extended into it as to obliterate all trace of the structure of the Lithistid; 4thly, that a *mould only* of the Lithistid structure may remain *in* the intruding flint; further, that in most cases the flint is homogeneous and nodular, while, on the other hand, the fragments of chert are heterogeneously composed and tabular—indicating that the former was more *exclusively* concretionary than the latter. On the surface of some enclosed specimens of Lithistina that I have knocked out from flint, the stelliform discoid stage in the development of the lithistid spicule remains on the surface, showing that nothing more than the thin, circular, discoid one had disappeared, which is a common occurrence even among recent specimens.

Apart, however, from the siliceous material which we call "flint," there may be a simple silicification of a calcareous shell, which would be a facsimile of the original form. Or, as I have shown in the sponge-spicules from the Carboniferous Limestone near Glasgow in Scotland, and Sligo in Ireland, respectively, the original material of the organic remains may undergo more than one change: thus as these spicules are now composed of chalcedony and yet present the rhombohedral excavations of calcite on their surface, they must previously have been carbonate of lime; and we know from their forms that they were *originally* siliceous spicules.

Under what circumstances these alterations take place, or how they may occur, or why the mineral should be changed, must be a matter of conjecture; but that they do occur we have evidence in the case just mentioned and in the formation of all mineral pseudomorphs; so that, if the *mould* of a Lithistid in flint, such as I have mentioned, were filled up with calcite and the flint subsequently removed, the original structure, instead of being siliceous, would be calcareous, or it might be pyritic, and so on. In two parcels of powder which came from the interior of two separate flints from Wallingford, Berkshire, the Coccoliths, which abound in both, are all silicified in one, and all calcareous in the other.

Where the siliceous material of which the flints and chert are composed came from I do not pretend to say, any more than the calcareous material which formed the kunker, especially the latter, seeing that out of eight analyses the quantity of lime only amounts to a mean of about nine parts in a thousand taken from the regur in eight different places, the lowest quantity of which, in three of the instances, did not reach two parts (Medlicott and Blanford, *op. cit.* vol. i. p. 430).

It may, however, be fairly inferred that the purer material will be found in the *nodular* forms, both of flint and kunker, and the less pure in the *tabular* forms, viz. the sheet kunker and the chert respectively.

Thus have I endeavoured to correlate that which may be said to be going on at the present day with what has taken place in ages past—not that such concretionary formations are confined to kunker and flint, for all geologists know that such have been taking place in the stratified deposits from the beginning; but to comprehend all, so far as we are able, is best accomplished by studying what is taking place at the present moment for comparison with what has taken place heretofore, since this kind of induction is the least exposed to error.

XXXI.—*General Considerations upon the Carcinological Fauna of great Depths in the Caribbean Sea and Gulf of Mexico.* By ALPHONSE MILNE-EDWARDS[*].

THE progress which submarine investigations have caused zoology to make exceeds any thing that could have been hoped for; and almost every day new facts are added to those already known. Those seas which had been best explored, and with regard to which naturalists thought there was nothing more to be learnt, have furnished unexpected discoveries when those zones which the fishermen do not usually reach came to be investigated.

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[*] Translated from the 'Comptes Rendus,' February 21, 1881.

I have already had occasion to call the attention of the Academy to the results obtained last summer on board the 'Travailleur' off the northern coast of Spain; and I dwelt especially upon the difference that exists between the animal population of the great depths and that of the surface or of the shores. When we compare their representatives it is as though we had before us two distinct faunas belonging neither to the same time nor to the same climate. The importance of this fact cannot escape any one; and geologists, in the determination of the age of a formation, must take it seriously into account. In fact, at the present day, in the same seas, there are in course of formation deposits, as to the contemporaneity of which there can be no doubt, and which contain the remains of perfectly dissimilar creatures. The animals of the littoral deposits belong to types of higher organization; those of the deeper deposits have a more ancient character: some of the latter present incontestable affinities with the fossils of the Secondary epoch; others resemble the larval condition of certain existing species.

The investigations which I have lately made of the Crustacea of the Caribbean Sea and Gulf of Mexico have furnished interesting results; and I think it worth while to say a few words about them. The materials I have had at my disposal were abundant and varied; for Mr. Alexander Agassiz had the kindness to send me for determination all the Crustacea collected by the expeditions of the U. S. navy during the years 1877, 1878, and 1879. A special ship, the 'Blake,' was fitted out for the performance of deep dredgings; and the harvests collected by her have proved most fruitful. I have now completed the examination of all the Brachyurous Decapods, of the Anomura, and the Cuirassed Macrura; I have described them in the Bulletin of the Museum of Comparative Zoology at Harvard College*; and now, treating the question from another point of view, I shall confine myself here to the indication of the general results at which I have arrived.

The number of species collected is much greater than would have been supposed from what was known of this part of the fauna; for the groups just enumerated it amounts to 214, of which 153 are new to science. Forty of these species differed too much from the forms previously known to take their place in existing genera, and I have been compelled to regard them as the types of new generic divisions. This variety of species is the more remarkable when we consider that fifty years ago the existence in these same regions of scarcely a score of Crustacea had been indicated.

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* "Études préliminaires sur les Crustacés," par A. Milne-Edwards (1e partie), Bull. Mus. Comp. Zool. Harv. Coll. tome viii. no. 1.

Certain groups, supposed to be foreign to the American seas, are, on the contrary, extraordinarily abundant at these great depths. Such is the family Galatheidæ, of which I have recognized forty-one species of very varied forms, and which I have had to distribute into eight different genera. Some of these have representatives in nearly all seas, such as *Galathea* and *Munida**. The others have never been met with elsewhere. Among these I may indicate the *Galacanthæ*, the carapace of which is armed above and on the sides with large sabre-shaped spines; the *Galathodes*, of which the eyes are very small, with imperfect corneola; the *Orophorhynchi*, in which the eye-peduncles are greatly reduced, spinous, and capable of concealing themselves in part beneath the rostrum; the *Elasmonoti*, with a carapace destitute of teeth or spines; the *Diptychi*, in which the abdomen is twice folded upon itself and concealed beneath the sternum; and, lastly, the *Ptychogastres*, which greatly resemble the preceding, but have the legs of unusual length.

The true Crabs, or Brachyurous Decapods, do not inhabit the very great depths of the Caribbean Sea. They abound on the shores; numerous species, but generally of small size, are found down to 500 metres below the surface; beyond this they seem to disappear. Nevertheless at 800 metres a crab with a square carapace, which I have described under the name of *Bathyplax*, was captured, representing in these seas the *Gonoplax* of our shores; but its eyes are atrophied and destitute of corneola, its orbits are rudimentary, and it is blind. On the other hand, the Anomurous and Macrurous Crustacea swarm at great depths. Down to 3500 metres there have been found representatives of the genus *Willemoesia*, those singular Macrura which almost exactly reproduce the forms of the Eryonidæ of the Jurassic period, but are blind, while the eyes of the above fossil Crustaceans appear to have attained their ordinary development. From a bottom of more than 4000 metres the dredge brought up some Galatheidæ of very remarkable forms, which I have placed in the new genus *Galathodes*.

* I have described two species of *Galathea* and eleven of *Munida*.

What is especially astonishing is the infinite variety of zoological forms, which often renders it almost impossible to apply the classifications which have hitherto been regarded as most firmly established. In fact, transition types abound, and we find numerous intermediate forms between groups that we were accustomed to consider very distinct. Of this I will give some examples.

The family Paguridæ, or the Hermit-Crabs, arranged by zoologists of most authority in the group Anomura, hitherto included only species which, although very numerous, were all very similar to each other, and without any direct connexion with the Macrura. The American dredgings have furnished unexpected forms, which unite the Hermit-Crabs with the Thalassinidæ. Such is *Pylocheles Agassizii*, the abdomen of which, instead of being soft and unsymmetrical like that of the *Paguri*, is composed of firm regular rings and terminated by a symmetrical fin. This Crustacean lives in holes, the entrance of which it closes with its claws, which, when they are united by their inner margin, constitute a very perfect operculum. The *Mixtopaguri* differ less from the *Paguri*; for their abdomen, which is more developed on the right than on the left side, is divided into seven distinct and movable joints, the first five of which are imperfectly calcified, while the last are large and hardened. In the *Ostraconoti* the carapace is entirely coriaceous, and the abdomen so reduced that the female, to hold her eggs, makes use of the legs of the fourth pair, the penultimate joint of which, widened into a palette, forms a sort of floor underneath the packet of eggs. The *Catapaguri* establish a passage between the preceding and the *Spiropaguri*: their abdomen is still very small, but twisted and lodged in little shells, the dimensions of which contrast strongly with the size of the carapace and legs, which remain outside. In some of these Crustaceans we also observe curious adaptations to a special mode of life. Thus *Eupagurus discoidalis*, inhabiting the tubular shell of the *Dentalia*, makes use of one of its chelæ as a circular operculum perfectly moulded to the orifice of the dwelling which it has to close. The *Xylopaguri* also merit our attention: they have never been found except in holes hollowed in fragments of wood; and whether it be a reed, a rush, or some branch, these cavities are always open at both ends; and the animal does not introduce itself backwards, as the ordinary *Paguri* do, but penetrates into its lodging directly. When there the chelæ always make their appearance at one of the orifices, the other being closed by the extremity of the abdomen, converted into an opercular buckler.

The family Dromiidæ, hitherto so distinct from the Homolidæ, is now united therewith by the genus *Homolodromia*, the legs of which also resemble those of *Dorippe*. The *Acanthodromiæ* are intermediate between the *Dromiæ* and the *Dynomenæ*; they have the buccal pieces, the eyes, and the antennæ of the former, and the ambulatory feet of the second. The *Dicranodromiæ* have the carapace narrower than that of the ordinary *Dromiæ*; its form resembles that of certain fossil Crustaceans of the secondary formations, of which the genus *Ogydromites* has been formed; the legs are very long, like those of the *Homolæ*. In *Homolopsis* also the body is more rounded and narrower than that of the last-named Crustacea; and in this respect they approach the Dromiidæ; but their eyes are nearly atrophied. The *Homolæ* are represented by two species, one of which appears to me to differ in no respect from *H. spinifrons*, hitherto found only in the Mediterranean. This is a fresh example of the immense geographical distribution attained by certain animals of the great depths. *Cymopolia*, of which one species also inhabits the Mediterranean, possesses eight in the Caribbean Sea. Some of them approximate to *Dorippe* by the intermediation of *Cyclodorippe* and *Cymonomus*; and these last-mentioned crustaceans, which are perfectly blind, have, on the other hand, close affinities with the *Ethusæ*. The genus *Ethusa*, supposed to be confined to the Mediterranean, must also be recorded among those of the American seas; among the Crustacea from the Florida reefs I have recognized a species and described it under the name of *E. americana*, only differing from *E. mascarone* by characters of but little importance.

The examples just cited suffice to give an idea of the interest attaching to the study of the animals from great depths. These bathymetrical researches are only commencing; and when we compare the small extent over which the dredge has been dragged with the immense spaces which have never been touched, when we reflect upon the manifold causes which render the retreats of certain animals still inaccessible to our means of investigation, we cannot avoid the conviction that the results obtained are only a very small part of those in reserve for us in the future. Hence we cannot too forcibly direct the attention of scientific men in all countries to the utility of coordinating their efforts and undertaking methodical investigations in the seas to which they have the most easy access.

Our zoological groupings now present so many gaps that it is impossible to understand the general plan which has presided over the grouping of living creatures. Palæontological discoveries on the one hand, and on the other those which are promised to us by submarine explorations, will gradually fill up these gaps, and perhaps one day enable naturalists to grasp the relations which exist between the different animals.

Our country has not remained indifferent to these researches; the Academy at its last meeting heard the interesting details given by M. de Lacaze-Duthiers upon the organization of his laboratory at Roscoff and the work that has been accomplished there. For my own part I am happy to be able to announce that the expedition accomplished last year in the Bay of Biscay by the 'Travailleur' will not be the last of its kind, and that this summer the same ship will undertake a series of dredgings in the Mediterranean, of which I shall have the honour to give you an account.

XXXII.—*On a Collection of Nocturnal Lepidoptera from the Hawaiian Islands.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The collection of which the following is an account consists of eighty specimens forwarded to me last year by the Rev. Thomas Blackburn. It is particularly interesting as being to a large extent composed of Micro-Lepidoptera, of which we have hitherto received very few species from the Hawaiian Islands.

Sphingidæ.

1. *Deilephila calida*, sp. n.

General size, form, and pattern of *D. euphorbiæ*, but the primaries coloured as in *D. biguttata* of Madagascar, and the secondaries differing from all species of the genus in their dark outer border; on the under surface the general coloration is bright brick-red. Primaries above smoky grey; a broad dark olive-brown belt across the base, three unequal subcostal spots, and a tapering discal belt of the usual form and also of a dark olive-brown colour; a narrow transverse fasciole forking from the inner margin of the discal belt to the costa; below this fork the belt is edged internally by a golden ochreous line; outer borders of a dark and slightly purplish-grey colour, decidedly darker than the central area of the wing; fringe with a slender whitish basal line: secondaries black, with narrow diffused sooty-grey border, scarcely paler than the ground-colour; a slightly irregular vermilion-red belt (a little narrower towards the costa) just beyond the middle of the wing; no trace of any white spot at the anal angle; costal border paler than the ground-colour; fringe white towards the anal angle, rose-coloured along the abdominal margin: body above dark olivaceous; the head, shoulders, and tegulæ bordered with sulphur-yellow; antennæ black, tipped with snow-white, ferruginous internally: abdomen with lateral white and black basal markings, nearly as in *D. euphorbiæ*, but narrower; three last segments bordered at the sides behind by narrow transverse cream-coloured spots; lateral margins dull rose-coloured. Wings below brick-red, crossed beyond the middle by two subparallel curved black lines (abbreviated in the secondaries); outer border rosy brown, with zigzag inner edge; discoidal area of primaries blackish, partly obscured towards the base by dull rosy hairs: body below pale rosy ferruginous; legs and palpi pale greyish brown, the base of the palpi and anterior tarsi whitish. Expanse of wings 2 inches 10 lines.

One specimen of this very distinct species was sent in a separate box. Mr. Blackburn gives the following description of the larva:—

"*Larva*. Pale green (belly whitish), sparingly dusted with white; dorsal and spiracular lines whitish, but rather obscure; first segment (*i. e.* the one behind the head) obscurely suffused with red; spiracles pink, with a crimson centre; head and legs green; claspers green, tipped with crimson; horn short and warty, black above, red beneath; head small; second and third segments behind the head much distended.

"Another individual was as follows:—Greenish grey, with a sooty appearance, sparingly sprinkled with rather large white spots; underside green; dorsal line yellow, very conspicuous; spiracular line white; spiracles yellow, with the centre dull orange; subspiracular line whitish, but very indistinct, excepting on last segment, where it forms a conspicuous white line on either side, converging to the horn. There is a general tendency in this form of the larva to a mauve-coloured suffusion in various parts of the body, which is very conspicuous when the larva is about half-grown.

"The two forms of larva described produced identical moths, though, I think, different sexes.

"I have taken it on several different plants (none of them known to me by name) in different mountain localities in Oahu. The imago flies by day in hot sunshine about flowers, and is also attracted by light in the evening."

Mr. Blackburn has also forwarded the following description of the larva of another hawk-moth, which I named in a previous paper *Protoparce Blackburnii* :—

"*Description of full-grown larva.* Green or ashy grey, more or less sprinkled with white; spiracular line white, emitting upwards and backwards (*i. e.* so that they slant upwards in a backward direction) seven white stripes, the first of which is on the fourth segment (not counting the head as a segment), the last on the tenth; on the eleventh segment is a small white stripe bent backwards over the spiracle, being much smaller than the white lines on the other segments; head with two well-defined black longitudinal lines, and clouded with black laterally; spiracles black, surrounded with a bright blue ring; horn long, shining black, bent backwards; claspers of the ground-colour. In the ashy grey larvæ the whole dorsal surface is sprinkled with white; the segment behind the head is shining black, bordered with white; the last claspers and space round the anus are shining black (at least partially); and the legs are blackish at base, becoming red towards apex. In the green larvæ only a few segments near the head are sprinkled with white, and the segment next behind the head, the last claspers and the space round the anus are olivaceous rather than black; the legs, too, are more conspicuously red.

"Feeds on a very common weed growing about 2 feet high, also on a shrub growing some 6 feet high, neither of which is known to me by name."

Larentiidæ.

2. *Scotosia corticea*, sp. n. (No. 116).

Bronzy brown: wings mottled all over with dark slaty grey, most distinctly on the primaries, where the mottling forms transverse striations; a rather broad central belt, formed of two stripes of a dark slaty-grey colour and the space between them, which is slightly paler; the outer stripe dentate-sinuate externally, both stripes inarched towards the costa of primaries; a discal stripe limiting the external border, parallel to the central belt, almost obsolete on the secondaries: primaries with traces of a curved slaty-grey stripe at basal fourth, and with the external border densely mottled with this colour: body greyish. Under surface paler than above, the wings very slightly striated with grey, excepting towards apex of primaries; an oval discocellular grey spot on each wing, largest on the primaries, the costal margin of these wings straw-yellow, mottled with black: body below whitish; venter transversely banded with grey; anus yellowish. Expanse of wings 1 inch 6 lines.

One specimen, in which the left primary is dwarfed; it has somewhat the aspect of a *Eubolia*, as noticed by Mr. Blackburn, but seems to agree better with *Scotosia*. Mr. Blackburn says:—"I captured two of this, at an elevation of about 4000 feet, on Haleakala, Maui, May 1880. The one sent was just out of pupa when taken; one side did not expand properly."

3. *Eupithecia monticolens*, sp. n. (No. 117).

Very closely allied to *E. bilineolata* from New Zealand, but darker, and with slightly less angular bands. Sordid shining greyish white: wings crossed by numerous subparallel undulated grey and brown lines, the interspaces between some of which are filled in with grey, so as to form fairly well-defined bands; the banding of the primaries is as follows:—two basal irregular bands, followed by a line; then comes the central belt, bounded on each side by a band and traversed by two lines; at the end of the cell is a transverse black spot on a scarcely perceptible diffused reddish shade; immediately beyond the central belt is a band of almost pure white, traversed by a single line; a submarginal slightly brownish band, the inner line of which is black; outer border grey; the veins varied with black and white, so as to form little black longitudinal dashes upon the dark bands: secondaries with a whitish band across the disk as in the primaries, but with no distinct dark bands, excepting on each side of the whitish one upon the abdominal area: body varied with grey; the abdomen crossed by two subbasal and one subanal black band; between these bands is also a dorsal series of four black dots. Primaries below greyish white; the discocellulars and the veins just beyond the cell black; apical area broadly bronzy, crossed by two curved ill-defined greyish stripes, and with the border of the same colour; these markings, however, entirely disappear in certain lights: secondaries sordid creamy white; a curved band just beyond the cell, formed entirely by a series of black longitudinal dashes on the veins; a marginal series of black dots: body below white; legs partly black above. Expanse of wings 10–11 lines.

Two specimens. "Not very rare about 4000 feet up Haleakala, Maui; I took it also at the summit of the mountain, 10,000 feet above the sea" (*T. B.*).

Noctuidæ.

4. *Spœlotis crinigera*, sp. n. (No. 11).

Colour of primaries and thorax similar to *S. ravida*, and exhibiting the same slight variations of tint from brownish to slaty grey, always as sericeous and sometimes more so than in that species; the markings on the primaries agree with those of *S. pyrophila*, excepting that they are black, with scarcely perceptibly paler borders: secondaries only differing from *S. pyrophila* in having the yellow line at the base of the fringe sharply defined and limited externally by an interrupted dusky line; abdomen greyish brown, the male with a very large anal tuft of long stramineous hair. Under surface shining white in the male, greyish in the female, with the discoidal area of primaries greyish in both sexes; internal area shining brassy opaline: a slightly dentate-sinuate discal grey stripe, abbreviated on the primaries: body below sandy yellowish in the male, sordid white in the female, dusky in front behind the palpi; tarsi blackish, with pale bands at the joints. Expanse of wings 1 inch 8 lines to 2 inches 3 lines.

Four specimens, in both sexes; Mr. Blackburn says of them, "I believe it to be identical with the *Agrotis* referred to in your papers in E. M. M. vol. xv. p. 269, and vol. xvii. p. 7, which was too much broken to be named, also with the insect described by you as *Spœlotis lucicolens*. How the number '12' (unless it be a misprint) got placed against the latter I cannot conjecture, for the number '12' is marked off from my note-book as non-existent, having been applied to a single worn specimen of a *Leucania*, which further study satisfied me was only *dislocata*, Walker." In this supposition Mr. Blackburn is partly correct; that is to say, this is the supposed "*Agrotis*;" but it differs from my "*Spœlotis lucicolens*," which (with "*S. cremata*") must be referred to *Agrotis*, in the simple instead of pectinated antennæ of the male: the species which must now stand as *Agrotis lucicolens*, although it possesses the general coloration and pattern of *Spœlotis*, is represented by a male specimen having strongly pectinated antennæ, as in *A. crassa* of Europe, to which it is probably most nearly allied. *A. cremata* also has the antennæ of the male exactly as in typical *Agrotis*, notwithstanding its *Spœlotis*-like pattern.

The specimen of *A. lucicolens* still has the No. "12" attached to it; so that it seems probable that this number when detached from the *Leucania* was accidentally transferred to the *Agrotis*. Of *Spœlotis crinigera* Mr. Blackburn says further:—"This insect is extremely common all over the Hawaiian archipelago, as I have found out since I penned the note from which you give extract calling it *rare*. I should say it is periodical in occurrence. I have taken it at all seasons of the year; but sometimes hardly a specimen is to be seen for months, then it swarms suddenly. At a place called Kawaihae, on the island Hawaii, in February 1879, I observed it literally in thousands round a lighthouse, evidently attracted by the lamps. The unset specimen (type of the male) was taken there; the largest specimen (type of the female) is from Maui, the other two from Honolulu. It does not usually occur much above sea-level, and does not thrust itself into notice much unless looked for about or soon after dusk, so is easily passed over."

With regard to *Agrotis* ("*Spælotis*") *cremata*, Mr. Blackburn says, "I think there is a mistake somewhere in the mention of Oahu as a locality for this species. I am only conscious of having had three specimens altogether, two of which I sent you in separate consignments. They were all bred from pupæ obtained in September 1876 in the Maui sand-hills. If I wrote No. 10 against any insect with "Oahu" as its locality it was a slip of the pen; nor do I even think it decidedly probable that the species occurs on Oahu, as that island has no region of sand-hills; and, moreover, Maui seems to contain many other species peculiar to it, many more, so far as my experience goes, than any other of the islands."

Apameidæ.

5. *Apamea chersotoides*, sp. n.

♂. Allied to *A. unanimis*, but with the coloration of a *Graphiphora*. Primaries shining laky brown, mottled with testaceous towards the base and along the costal border; costal margin spotted regularly with black; basal area crossed by oblique interrupted slightly zigzag black lines, which appear to be continuous with the first two pairs of black costal spots; four ill-defined, reversed, oblique, dentate-sinuated black lines, the first, third, and fourth attached to minute whitish points; the first line (which runs from the "orbicular" to the inner margin) very indistinct, the last line limiting the external border, which is dusky; a discal series of black dots; an oblique subapical costal black dash; a marginal series of small lunate black spots, followed by a testaceous marginal line; base of fringe dark brown, remainder of fringe red-brown; orbicular and reniform spots whitish, with black-speckled centres: secondaries grey, the veins and a diffused outer border fuliginous brown; costal border whitish, shining, with brassy reflections; fringe cream-coloured, traversed by a brown line; thorax laky brown, the collar crossed by scarcely perceptibly darker lines; abdomen grey, becoming brown towards the anus, and fringed on each side with lake-brown hair; anal tuft orange. Wings below sericeous whitish, with the borders pale rosy testaceous, speckled with black; black discocellular spots; a dusky angulated discal line; external border greyish; a marginal series of lunate black dots; fringe with a pale yellowish basal line: primaries with the discoidal area greyish; fringe reddish: secondaries with the fringe crossed by a grey line and tipped with white: body below dull rose-colour; venter with lateral black dots. Expanse of wings 1 inch 3 lines.

♀. Darker than the male, the markings more distinct, the black lines across the basal area distinct and continuous with the costal spots, the discal series of black dots attached to whitish dots, and therefore having the appearance of an extra discal line; abdomen dark greyish brown. Otherwise as in the male. Expanse of wings 1 inch 4 lines.

A pair in good condition. "Various localities on Maui, April and May 1880."

6. *Apamea cinctipennis*, sp. n. (No. 140).

Aspect of *Chersotis*, but with the border of the primaries almost as pale as in *Apamea limbata*. Primaries above shining laky brown, mottled all over, excepting upon the outer border, with black; outer border pale dead golden or sandy brown, slightly speckled with black; a marginal series of black lunate spots; costa, disk, and basal area mottled with pale testaceous; a zigzag black-bordered pale testaceous stripe at basal third, and a curved series of internally black-bordered testaceous spots across the disk; discoidal cell blackish, the ordinary spots slaty grey, edged with black; the outer margin of the reniform spot angulated and whitish; fringe pale testaceous and laky brown in alternate lines: secondaries shining grey, with dusky diffused outer border; fringe pale testaceous, intersected by a dusky line; thorax slaty grey, varied with brown; abdomen shining grey, with ochreous anal tuft. Under surface whitish grey, shining: wings with black-speckled sandy-tinted borders; discocellular and marginal black spots; venter ochreous, with lateral series of black spots. Expanse of wings 1 inch 8 lines.

One specimen. I can find no reference to the No. ("140") in Mr. Blackburn's notes, and therefore am ignorant as to the exact locality for this species.

Heliothidæ.

7. *Heliothis armigera* (Nos. 141 and 154).

Noctua armigera, Hubner, Noct. pl. 79. fig. 370 (1805–24).

A pair. The male (No. 141) is a faintly-marked variety exactly resembling *H. incarnata* on the upper surface, excepting that the fringe is not rosy; the female, on the other hand, is a rather dark specimen, nearly approaching the form found in New Zealand and named *Heliothis conferta* by Walker, with which it may be conspecific; as, however, the difference between *H. armigera* and *H. conferta* is apparently only one of colour, it is very doubtful whether the latter is more than a variety of the former. Of the male Mr. Blackburn says:—"I took three specimens flying at flowers, at an elevation of about 2000 feet, on Haleakala, Maui, in May 1880; the specimens are all identical in size and markings &c., save that one (which I retain) has the marginal dark band of the hind wings narrower than the other two." Of the female he says:—"I took the specimen sent at a lamp in Honolulu, attracted by the light; a second, which I retain, occurred to me in company with ** No. 141."

Hypenidæ.

8. *Hypena obsoleta* (No. 14).

Hypena obsoleta, Butler, Ent. Month. Mag. xiv. p. 47 (1877).

Two specimens, one of which is an interesting variety, having the central belt of the primaries bordered (narrowly internally and broadly externally) with pale stramineous. Mr. Blackburn still considers the species to be conspecific with *H. insignis*; but at present I have not sufficient evidence before me to unite them, the variety now sent not being intermediate. The following is what Mr. Blackburn says:—"I feel compelled, however presumptuous it may seem in one who does not profess to be a specialist in Lepidoptera, to hesitate much in regarding *obsoleta* and *insignis* as distinct. The species (or group of species) occurs all over the Hawaiian archipelago: I have specimens from Hawaii, Maui, and Oahu; I have seen it in my own garden and at an elevation of 4000 feet. Among twenty specimens which I have set, there are only two that cannot be said to differ *inter se*; and they are of the form '*insignis*.' Two extreme forms I possess are:—the one sooty black, with faint indications of the lines which border the dark area in '*insignis*;' the other sooty black, with the same lines sulphur-yellow. Another specimen is pale grey, with the same lines nearly black; another dark fuscous, with a still darker cloud representing the dark area of *insignis*, but extending further before it reaches the costa. The hind wings vary through all shades from pale ashy to nearly black. Classified by locality, I can detect no difference, except that the specimens from the south of Hawaii generally have darker hind wings."

The preceding note certainly seems to show that *H. obsoleta* is extremely variable; and yet the observation that the two specimens which agree are referable to "*H. insignis*" seems to show that the gradation from one form to the other is not perfect, and therefore that we may have here, as in the British butterflies of the genus *Pieris*, nearly allied species widely distributed and occurring constantly together, which nevertheless are distinct; nothing but breeding can satisfactorily decide the point, unless a perfect gradation can be shown; and even this is not always conclusive. In all probability the larva would be found abundantly on nettles.

9. *Hypenodes altivolans*, var. *simplex* (No. 65).

Scoparia altivolans, Butler, E. M. M. xvii. p. 9 (1880).

Primaries above bronzy brown, shining; a dusky-edged zigzag clay-coloured stripe across the basal third, followed within the cell by a short oblique black dash; a second arched clay-coloured stripe with dusky inner edge across the external third, followed by an irregular abbreviated stripe of the same colours; a submarginal lunulate white line breaking up into small annular or ocellus-like spots towards the inner margin; a marginal series of black impressed dots followed by an interrupted pale line at the base of the fringe; secondaries shining pale grey; thorax bronzy brown, abdomen greyish brown. Under surface uniformly grey. Expanse of wings 9½ lines.

Var. Primaries above darker than in the type, the clay-coloured stripes only indicated by their dusky margins, excepting towards the inner margin, also more irregular; thorax darker; otherwise similar. Expanse of wings 8 lines.

Three specimens. "It occurs all over the Hawaiian archipelago; but I have not observed it to be common" (*T. B.*).

Hercynidæ.

10. *Boreophila minuscula*, sp. n. (No. 134).

Leaden grey above; primaries with the basal third dusky, crossed by an acutely angulated black line, and limited externally by an angular black stripe followed by a white stripe; two angulated black-edged ochreous stripes representing the central belt; a diffused white costal spot immediately beyond the outer stripe; an irregularly falciform snow-white discal line; a marginal series of black dots; fringe whitish, spotted with blackish and intersected by a black line; secondaries very slightly greenish in tint as compared with the primaries, with a slender whitish submarginal line followed by a slender black marginal line; fringe whitish, intersected by a grey line; palpi, head, and thorax dusky. Under surface dark shining leaden grey; wings with whitish submarginal and blackish marginal lines; fringe as above; primaries with white internal border: pectus and under surface of legs white; tarsi above blackish, banded with white. Expanse of wings 6½ lines.

One specimen, taken "at light at an elevation of about 4000 feet on Haleakala, Maui."

11. *Aporodes? micacea*, sp. n. (No. 118).

Primaries above shining slaty grey, shot with purple and clouded with black; a creamy whitish irregular subbasal band, densely irrorated, excepting along its borders, with black scales; orbicular and reniform spots well-defined, black, varied with clay-colour; a very irregular dentate-sinuate black discal line partly bordered externally with white and golden orchreous, a large cuneiform costal ochreous patch beyond the discal line, spotted, upon the costal border, with black; outer and inner borders irrorated with ochreous; two marginal alternated series of black spots, and between the spots of the outer series snow-white dots; fringe intersected by two black lines and spotted externally with ochreous: secondaries greyish brown, with bronzy reflections; costal border silvery whitish towards the base; fringe whitish, spotted with blackish and intersected by two lines of the same colour: body black, with the thorax and anterior abdominal segments spotted with rosy cupreous, posterior segments altogether of this colour; the anterior segments also have snow-white posterior margins. Wings below cupreous, shining, with an alternately black and white marginal line and silky white fringe; primaries shot with pale greyish blue, so that in certain lights the whole tint of these wings is entirely altered; costal border red, spotted with black from the end of the cell; orbicular and reniform spots large and black; discal line of the upper surface indicated but indistinct; secondaries reddish all over and irrorated with black; the interno-median area and a streak through the cell snow-white, speckled with black, excepting on the veins, which remain reddish; a discal series of white-bordered black spots; three black spots in the cell, and one at the inferior extremity of the cell; pectus shining silvery white; legs dull red, banded with black and white; venter white towards the base, but red towards the anal extremity. Expanse of wings 11 lines.

Two specimens of this beautiful little species. According to Mr. Blackburn it is "common, at an elevation of about 4000 feet, on Haleakala, Maui; generally flying over ferns."

I am extremely doubtful as to the affinities of this species. Although in structure it seems to agree with *Aporodes*, it has much the aspect of a Noctuid allied to *Acantholipes*; the distinct orbicular and reniform spots and the highly coloured under surface are by no means characteristic of typical Hercynidæ.

Margarodidæ.

12. *Margaronia glauculalis* (No. 114).

Margarodes glauculalis, Guénée, Delt. et Pyral. p. 306. n. 325 (1854).

"The specimen sent was brought to me dead; and I could do nothing with it but gum it on a card. After an interval of nearly two years I procured a second specimen in fine condition at light. The specimens are so absolutely identical that you will not hesitate to treat the somewhat unsightly one I send as a type. Both were taken in Honolulu."—*T. B.*

The species is very widely distributed, being found also in Java and Sumatra. It ought to be common, if one may judge by the abundance of some of the allied species.

Botididæ.

13. *Anemosa aurora*, sp. n. (No. 143).

Allied to "*Scopula*" *daiclesalis* of Walker*, but much smaller: primaries above bright rose-colour, with a slight lilac reflection; the ordinary lines very indistinct but ochraceous; fringe golden ochreous tipped with whitish: secondaries shining golden ochreous, paler towards the abdominal border, whitish on the costal border, slightly greyish at apex; a marginal series of minute black dots between the veins; fringe tipped with white: body dark ochraceous, the thorax and posterior segments of the abdomen washed with lake-red; margins of abdomen silvery. Wings below cream-colour, with golden reflections: primaries with whitish internal border; costal margin rose-colour; an oblique annular oval marking representing the reniform spot and a diffused arched line beyond the cell grey; secondaries with a marginal series of black dots: body below sericeous white; palpi red at the sides. Expanse of wings 8½ lines.

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* The genus *Anemosa* differs from *Scopula* in its considerably longer palpi and acute primaries.

One specimen in good condition. I can find no reference to the number, and therefore cannot record its exact locality.

14. *Mecyna ennychioides*, sp. n. (No. 135).

Dark fuliginous brown: wings with shining slaty-grey reflections; a marginal series of black dots; fringe tipped with white; primaries with the usual markings characteristic of *Botys*, black, as follows:—a black dot before the middle of the cell, the orbicular and reniform spots represented in outline; a bisinuate abbreviated line from the orbicular spot to the inner margin, and the usual alternately angulated (or castellated) discal line from costa to inner margin; apical half of costal margin black, spotted with testaceous: secondaries with white costa: body blackish, the abdomen with a bluish gloss. Under surface, excepting that it is altogether less red, is almost identical in pattern with *Aporodes? micacea*. Expanse of wings 10½ lines.

One specimen, taken at light, at an elevation of about 4000 feet, on Haleakala, Maui.

The extraordinary resemblance which this species bears to *Aporodes? micacea* on the under surface makes me doubt, notwithstanding its many structural differences, whether it is not the male of that species; yet on the upper surface the pattern and colouring are very different; the form of the primaries, the length and form of the palpi, and the length of the tibiæ and tarsi are altogether dissimilar.

15. *Mecyna nigrescens*, sp. n. (No. 136).

Primaries above dark brown, clouded in the centre with pale buff, which colour fills the intervals between the discoidal spots; all the markings similar to those of the preceding species, excepting that the orbicular and reniform spots are dark brown with black margins, that there are two additional black spots close to the base, that the two transverse lines are bordered with pale buff and white, that there is a whitish nebula near the apex and a white oblique stripe from the discal line to the outer margin, that the marginal black dots are bordered with white and the fringe is spotted with pale buff: secondaries shining fuliginous brown, with the basal half of the costal border white; two black spots in the cell, fringe spotted with white: thorax pale buff, speckled with black; abdomen black, with white hind margins to the segments. Primaries below grey, with silvery white internal border; costal border cream-coloured, spotted with black beyond the middle; discoidal spots large and black; an indication of the discal line of the upper surface; outer border and fringe nearly as above, but greyer and more sericeous: secondaries greyish white, with two black spots in the cell and one at the inferior extremity; a discal series of black dots; a submarginal dentate-sinuate grey line; a marginal series of black dots; a white apical spot; fringe spotted with grey: body below white; venter with lateral series of black dots. Expanse of wings 8 lines.

One specimen, "flying among low plants at an elevation of about 4000 feet on Haleakala."

16. *Mecyna exigua* (No. 133).

Mecyna exigua, Butler, Ent. Month. Mag. xv. p. 271 (1879).

One specimen, without head; it is probably the female of my species; and differs in the diffusion of the white edges of the black lines across the primaries; so that these wings might be described as greyish white, dusky at the base and crossed in the middle by a broad irregular blackish belt; a subapical costal spot and the outer border blackish; a marginal series of black dots, limited internally by a zigzag submarginal white line; fringe grey, traversed by a brown line and tipped with brown. Expanse of wings 10 lines.

No exact locality is given. "April–May."

17. *Mecyna virescens*, sp. n. (No. 139).

Allied to *M. polygonalis* of Europe and *M. deprivalis* of New Zealand; same size and pattern above: primaries above olive-green; costal margin dark orange; an indistinct angulated oblique darker line just before the basal third; orbicular and reniform spots small and dusky; a large black spot just below the inferior angle of the cell, and two or three black dots in a straight line between it and the inner margin; an arched series of five black dots beyond the cell; a marginal series of black points; fringe of inner margin sienna-red; fringe of outer margin grey in the centre, sienna-red at base and tips: secondaries dull cupreous brown, with a black border as in the allied species, fringe golden cupreous, traversed by a central grey line: thorax olive-green, abdomen pale sandy brown. Primaries below with the costal border and apex reddish orange; subapical area broadly dull rose-colour; discoidal area grey; disk towards external angle flesh-coloured; internal border white; a whitish-buff basal spot and an indistinct rosy subcostal streak in the cell, interrupted by blackish orbicular and reniform spots: secondaries pale sandy yellow, washed with rose-red, especially on costal and external areas; a greyish outer border: fringe of all the wings cream-coloured, traversed by a grey stripe: body below cream-coloured, femora and tibiæ reddish. Expanse of wings 1 inch 2 lines.

One specimen. This is the first *Mecyna* of the typical group received from the Hawaiian islands. Mr. Blackburn says of it, "I send a specimen (one of two) bred from larvæ found feeding on a tree unknown to me by name, but apparently a species of *Acacia*, which I have not seen growing elsewhere than in damp ravines at an elevation of 4000 to 5000 feet on Haleakala, Maui. A third specimen I took flying by day in the same locality; it is larger, exp. al. 38 millims., ground-colour of front wings as bright yellow as the cilia of hind wing in the specimen sent, otherwise identical; probably the other sex. The other bred specimen is identical with the one sent.

"The following is a description of the larva:—Shining black, sparingly furnished with long grey-white hairs; head and underside dirty grey; spiracular line bright orange-colour; three pairs of legs (on three segments next behind head), and five pairs of claspers, all dirty semitransparent grey. Forms a pupa in a silken cocoon."

The entirely different character of the under surface readily distinguishes this species from its allies.

Scopariidæ.

18. *Scoparia hawaiensis*, sp. n. (No. 83).

Closely allied to *S. exhibitalis* of Australia and *S. lætalis* of Europe: primaries above grey, densely speckled with black, crossed near the base by an angulated cream-coloured belt, broadly bordered and sparsely speckled with black; a hastate black spot in the cell; end of the cell filled by a milk-white spot; a black rhomboidal spot just beyond the cell, a black spot partly surrounded by white scales below the discoidal hastate spot; external third densely irrorated with milk-white scales, which form two ill-defined stripes, the inner one zigzag and discal, the outer one submarginal; two subapical costal spots, a nearly marginal confluent series of unequal spots, and a large spot on the inner margin near the external angle black; a marginal chain-like series of small elliptical white spots, bounded externally by a slender black line; fringe sericeous sordid white, tipped with grey and traversed near the base by a black line: secondaries sericeous sordid white like tarnished silver, fringe with greyish outer half and a grey subbasal line: thorax black, spotted with cream-colour; abdomen silvery white, anal tuft testaceous; tarsi black above, banded with white. Under surface uniformly silvery white. Expanse of wings 8 lines.

Two specimens. Mauna Kea, Hawaii; elevation about 7000 feet.

19. *Scoparia jucunda*, sp. n. (No. 82).

Allied to the preceding, but with somewhat the aspect of *Tinea nigralbella*; primaries above sericeous white, with a very slight bluish tinge, adorned with black markings as follows —a dentate sinuate band close to the base, an irregular patch across the cell interrupted transversely by two spots of the ground-colour and terminating below the median vein in a curved line, which runs along nearly a fourth of the inner margin, an oblique streak beyond the cell and a zigzag marking (which may, in some specimens, be continuous with the latter) at external angle, an apical patch interrupted by two oblique stripes of the ground-colour and a marginal series of dots; secondaries shining sordid white; head and thorax white, slightly bluish; abdomen shining pale brown, with testaceous anal tuft. Under surface sordid silvery white. Expanse of wings 8½ lines.

One specimen. Mauna Kea, Hawaii; elevation about 7000 feet.

Var. *formosa* (No. 130).

Much more heavily marked than the preceding, the black markings on the primaries being broad and intense in colouring, the patch across the cell altered in shape so as almost to resemble the Greek υ, the outer extremity uniting with the oblique streak beyond the cell; shoulders and back of collar black. Expanse of wings 9 lines.

One specimen. Found "occasionally on trunks of trees, at an elevation of about 4000 feet on Haleakala, Maui."

This can at most be no more than a local modification of the preceding (*S. jucunda*); it, however, reminds one rather of *Psecadia pusilla* than of *Tinea nigralbella.*

20. *Scoparia frigida*, sp. n. (Nos. 67 and 81).

Nearly allied to *S. rakaiensis* of New Zealand, but much smaller, with slightly different pattern on the primaries and no broad border to the secondaries: primaries above shining brownish grey irrorated with white; an acutely angulated black-edged white line across the basal third; three white-edged abbreviated longitudinal black lines at the base; several scattered black spots in the cell, the largest of these being placed longitudinally within the inferior angle of the cell; a bidentate trisinuate white discal stripe partly bordered externally with black, the central arch or sinus uniting with the middle of a bisinuated submarginal white stripe; a nearly marginal series of black spots, followed by a black-edged marginal white line; fringe with the base and a slender line just beyond the middle grey: secondaries shining bronzy whitish, with a grey line close to the margin; fringe white, with the base and a slender line grey: thorax white varied with brown; abdomen bronzy whitish. Under surface silvery whitish. Expanse of wings 9½ to 10 lines.

Two specimens, of which one was "taken flying at an elevation of about 4000 feet on Haleakala, Maui," and the other at "Mauna Kea, Hawaii; elevation about 7000 feet."

21. *Scoparia coarctata* (No. 102).

Eudorea coarctata, Zeller, Linn. Ent. p. 308. 14 (1846)

One specimen. No exact locality given.

22. *Scoparia venosa*, sp. n. (No. 84).

Primaries above black with white veins; a white marginal line followed by a black line at the base of the fringe; tips of fringe grey: secondaries pale shining brown, with a white marginal line followed by a blackish line at the base of the fringe, which is white tipped with grey: head and thorax black, spotted with white; abdomen pale shining brown. Wings below pale shining brown, with marginal line and fringe as above: body below silvery white. Expanse of wings 9½ lines.

Two specimens. "Mauna Loa, Hawaii; elevation about 4000 feet; occurred very near the active volcanic crater."

Phycidæ.

23. *Ephestia humeralis*, sp. n. (No. 111).

Allied to *E. elutella*; general coloration similar, but the pattern quite different: primaries above shining silvery grey, with the basal half of the costal border snow-white; fringe white: secondaries greyish white, shining; veins and marginal lines grey; fringe snow-white, traversed near the base by a slender grey line: body above silvery grey. Primaries below grey, shining; secondaries and body below silvery white. Expanse of wings 8½ lines.

One specimen. "Mountainous places on Oahu and Hawaii. I have taken only two specimens."—*T. B.*

24. *Ephestia albosparsa*, sp. n. (No. 80).

Allied to *E. semirufa*, very similar in general pattern: primaries above shining leaden grey, irrorated with white; an oblique white stripe at basal third, immediately followed by a broad externally angulated leaden-grey band; a faint indication of a reniform spot, owing to the less densely congregated white scales at the end of the cell; a regular white stripe with leaden-grey internal border parallel to and near the outer margin: secondaries shining brownish white (like slightly tarnished silver), with snow-white fringe traversed near the base by a slender grey line: thorax grey; abdomen silvery whitish. Primaries below shining greyish brown; secondaries as above, excepting that they are whiter: body below silvery white. Expanse of wings 8½ to 9½ lines.

Two specimens. "Various localities on Hawaii."

[To be continued.]

XXXIII.—*Description of* Parantirrhœa Marshalli, *the Type of a new Genus and Species of Rhopalocerous Lepidoptera from South India.* By J. Wood-Mason, Deputy Superintendent, Indian Museum, Calcutta.

Family **Nymphalidæ**.

Subfamily *Satyrinæ*.

PARANTIRRHŒA *, gen. nov.

♂. Anterior wings triangular; anterior margin moderately and regularly arched; apical angle acute; outer margin almost straight, being only just perceptibly convex; inner angle rounded; inner margin sinuous, being lobed at the base much as in the males of *Clerome* and *Æmona*, genera of Morphinæ; subcostal vein 4-branched, the first branch given off before and the second beyond the end of the discoidal cell, the first, second, and third coalescing successively and respectively with the costal vein, the first and the second and all three in turn becoming free and running off at a tangent, like the costal vein, to the anterior margin, the fourth being perfectly free from its origin and running to the apical angle; posterior discocellular veinlet long, very slightly concave outwards, almost straight, intermediate one not quite half the length of the posterior, anterior one rudimentary; submedian vein sinuous, short, terminating in the wing-membrane near the inner margin at about the level of the junction of the basal and second fourth of the length of that margin, being, in fact, hardly more developed than is the internal vein of the Papilioninæ as compared with that of many Heterocerous Lepidoptera; the first median veinlet directed straight outwards and backwards, out of its normal course, to the inner angle, and supplying the place of the rudimentary submedian. On turning to the underside it is seen that a narrow rounded lobe of the functional sutural area, about six times as long as it is broad, is folded back upon the under surface, to which it is firmly adherent; this lobe occupies the middle two fourths of the length of the inner margin, and is thickly clothed on its surface and fringed at its free edge with firmly attached, long, and somewhat raised modified scales, rendered conspicuous by their rich dark brown colour and satiny lustre; the outline of this turned-up lobe is marked out on the upperside by a curvilinear groove.

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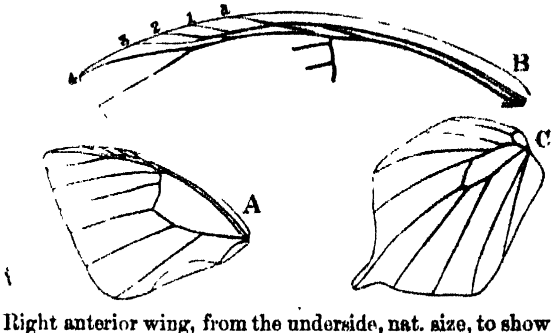
* From παρὰ, by the side of, and *Antirrhœa*, generic name.

Posterior wings tailed, subquadrate, with four distinct margins, viz. a strongly and irregularly-arched anterior margin, nearly straight external and posterior margins, and an inner or abdominal margin, marked out by the obtuse-angled apex, the tail, and the well-rounded anal angle; with a black oval sexual mark, divided by the submedian vein, near the anal angle; costal vein short and straight, terminating before, and the first branch of the subcostal, which originates close to the base of its vein, ending beyond the middle of the length of the anterior margin, the second branch being given off



A. Right anterior wing, from the underside, nat. size, to show the whole venation and the inflected lobe of the inner margin. B. Anterior portion of the same, much enlarged, to show the relations of the veins to one another: *a*, costal vein; 1, 2, 3, 4, terminations of the four branches of the subcostal vein. C. Right posterior wing, from the underside, nat. size.

before the middle of the discoidal cell and extending into the apical angle; "discoidal" vein in the same straight or slightly curved line with the subcostal; discocellular veinlet sinuous; the third median veinlet produced to a conspicuous tail.

Antennæ fine and distinctly clubbed.

Female unknown.

No Asiatic genus of Satyrinæ presents us with any approach to the remarkable arrangement of the two hindermost veins of the anterior wings described above; but in the South-American genus *Antirrhœa* we meet with identically the same arrangement, the first median veinlet in the males of *A. archæa* and its congeners running back to the inner angle, and the submedian vein ending a considerable distance short of that angle, though not nearly so far short of it as in the Indian form, for which I propose the above name, in allusion to these remarkable points of resemblance, reserving all further comparisons and comment until I shall be in possession of specimens of the South-American forms.

The species of the genus *Elymnias* alone exhibit the same disposition of the three anterior veins of the posterior wings.

Parantirrhœa Marshalli, n. sp.

♂. Wings above dark fuscous, suffused with rich deep violet.

Anterior wings with an outwardly and forwardly arched subcrescentic pale violet or mauve band, commencing beyond the middle of the wings at the costal vein, terminating at the inner angle, and crossed obliquely by a series of three small white spots disposed in a straight line parallel to the outer margin, and placed upon folds of as many consecutive cells, the last being between the two anterior median veinlets.

Posterior wings relatively longer-tailed than in *Melanitis ismene* (Cramer), with the membranous parts of the divergent tails almost wholly formed by the produced wing-membrane of the interspace between the second and third median veinlets, a very narrow anterior membranous edging only being contributed by the interspace next in front, and with rather more than the basal two thirds of their length in front of the discoidal and subcostal veins ochreous.

Wings below ochreous, obscurely striated with a deeper shade of the same colour, and marked with a submarginal series of inconspicuous brown specks, the probable rudiments of ocelli.

Length of anterior wing 1·16 inch, whence expanse = 2·4 inches.

The female will in all probability prove to differ from the male not only in the absence of the sexual spot on the posterior wings, but also in having the inner margin of the anterior wings straight and neither lobed at the base nor turned up in the middle, and the first median veinlet and the submedian vein of the same wings normally arranged and developed and directed respectively to the outer margin and to the inner angle, after the manner usual amongst butterflies.

Hab. Trevandrum, Travancore, South India. Described from four specimens of the male—one (the type) recently purchased by the Indian Museum, and three the property of Capt. G. F. L. Marshall, R.E., to whom I am indebted not only for the opportunity of describing this interesting insect, but also for permission to dissect one of the specimens in his collection.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

January 19, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Further Notes on the Family Diastoporidæ, Busk." By G. R. Vine, Esq. Communicated by Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S.

In continuing his review of the family of the Diastoporidæ, the author stated that upon the question of the classification of the Polyzoa he is inclined to accept the views recently published by the Rev. T. Hincks, in preference to the earlier ones enunciated by Prof. Busk. He now described the forms found in the Lias and Oolite, including *Diastopora stromatoporides*, Vine (=*liassica*, Quenst.), *D. ventricosa*, Vine, *D. oolitica*, Vine, *D. cricopora*, Vine.

The author then proceeded to argue against the inclusion of the foliaceous forms in the genus *Diastopora*, and concluded by giving a definition of the genus as now limited by himself.

2. "Further Notes on the Carboniferous Fenestellidæ." By G. W. Shrubsole, Esq., F.G.S.

The author pointed out the discrepancies in the descriptions given by Lonsdale, Phillips, M^cCoy, and King of the genus *Fenestella* as represented in the Silurian, Devonian, Carboniferous, and Permian formations respectively. He then proposed a new definition of his own, and described the following species—*F. plebeia*, M^cCoy, *F. membranacea*, Phil., *F. nodulosa*, Phil., *F. polyporata*, Phil., *F. crassa*, M^cCoy, *F. halkinensis*, sp. nov.; and in conclusion he pointed out that the few species to which he has reduced the Carboniferous *Fenestellæ* find their representatives in the North-American continent, only one really new form, *F. Norwoodiana*, having been described there.

February 2, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Coralliferous Series of Sind, and its Connexion with the last Upheaval of the Himalayas." By Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S.

This communication is the result of the author's study and description of the fossil corals of Sind, undertaken at the request of the Geological Survey of India. The history of the researches in the geology of the Tertiary deposits of Western Sind was noticed in relation to a statement made some years since by the author and Mr. H. M. Jenkins, F.G.S., that there was more than one Tertiary series there, in opposition to both D'Archiac and Haime.

After a brief description of the geology of the Khirthar and Laki ranges of hills, which were called Hala Mountains by the French geologists, the succession of the stratigraphical series demonstrated by the Survey under Blanford and Fedden was given, and the author proceeded to discuss the peculiarities of the six coral faunas of the area, and to argue upon the conditions which prevailed during their existence. A transitional fauna, neither Cretaceous nor Eocene, underlies a trap; to the trap succeeds a great development of Nummulitic beds, the Ranikot series, containing corals, some of which are gigantic representatives of European Nummulitic forms. A third fauna, the Khirthar, succeeds, and a fourth, Khirthar-Nari, which was a reef-building one; and a fifth, the Nari, is included in the Oligocene age. An important Miocene coralliferous series (the Gaj) is on the top of all. These faunas above the trap are Nummulitic, Oligocene, and Miocene in age; and in the first two, European forms which are confined to definite horizons are scattered indefinitely in a vertical range of many thousands of feet. The corals grew in shallow seas; but most of them were not massive limestone-builders, but there were occasional fringing reefs, or rather banks of compound forms, which assisted in the development of limestones. Many genera of corals which elsewhere are massive, are pedunculate in Sind; and the number of species of the family Fungidæ is considerable. There are also alliances with the Eocene coral fauna of the West Indies.

The depth of the coralliferous series and the intercalated unfossiliferous sandstones &c. is, according to the Survey, 14,000 feet, without counting an estimated 6000 feet of unfossiliferous strata in one particular group. The subsidence has therefore been vast, but not always continuous.

After noticing the numbers of genera and species in this grand series of coral faunas and the remarkable distinctness of each, the author proceeded to discuss the second part of his subject. When President of the Society, he had stated, in his Anniversary Address for 1878, that he was not convinced of the truth of the theory of the Geological Survey of India regarding the Pliocene age of the last Himalayan upheaval. The considerations arising from the position of a vast thickness of sedimentary deposits overlying the Gaj or marine Miocene, and containing *Amphicyon*, *Mastodon*, *Dinotherium*, and many Artiodactyles of the supposed pig-like ruminant group, lead to the belief that the author was not justified in opposing the theory enunciated by Lydeker and the Directors of the Survey. The position of these Manchhar strata on the flanks of the mountain-system of Sind was compared with that of the sub-Himalayan deposits. The faunas were compared, and the Sewalik deposits, the equivalents of the Upper Manchhar series of Sind, were pronounced to be of Pliocene age. They were formed before and during the great upheaval of the Himalayas, and in some places are covered with glacial deposits.

A comparison was instituted between these ossiferous strata and the beds of Eppelsheim and Pikermi; and the author discussed the question relating to the age of terrestrial accumulations overlying marine deposits.

2. "On two new Crinoids from the Upper Chalk of Southern Sweden." By P. H. Carpenter, Esq., M.A. Communicated by Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S.

Stem-joints of a Crinoid resembling those of *Bourgueticrinus* have long been known in the Plänerkalk of Streben (Elbe); but on the discovery of the calyx it was found to differ considerably from that genus. It was then referred to the genus *Antedon* by Prof. Geinitz. Stems also resembling *Bourgueticrinus* have been found in the Upper Chalk of Kopinge (S. Sweden); and a calyx resembling that described by Prof. Geinitz has also been found. Prof. Lundgren kindly intrusted this to the author for description.

For these two fossils he considers not only a new genus but also a new family required. He proposes for the former the name *Mesocrinus*, as the characters of its calyx ally it to the Pentacrinidæ. The author describes the characteristics of the genus *Mesocrinus*, and of the species *M. suedica* (the Swedish species), and its differences from *M. Fischeri* (from Streben), and discusses the relationships of the genus, which combines the characters of a *Pentacrinus*-calyx with a *Bourgueticrinus*-stem.

A new species of Comatula (*Antedon impressa*) from the Ignaberga Limestone of Scania was also described, and its systematic position discussed.

DUBLIN MICROSCOPICAL CLUB.

January 15, 1880.

Nostoc paradoxum, Welw.—Prof. E. Perceval Wright, in exhibiting a minute portion of *Nostoc paradoxum*, Welw., said that he had been able, through the kindness of Mr. Carruthers, to forward morsels of four so-called Nostocs from Dr. Welwitsch's collection to Dr. Bornet, who was engaged in working out the species of this group, and that he had found that No. 19, from "Mossamedes, at an elevation of 1000 feet" (1859), was *Glœotrichia natans*, Thuret. No. 20, "*N. paradoxum*," might perhaps be a distinct thing; but the specimen found "ad muscos denso cæspitosos, juxta rivulos pr. Pedra Souague in ipso Præsidio, 1857," was both sterile and young; and if Dr. Bornet had found such in France he would not have hesitated to refer it to *Nostoc ellipsosporum*. No. 21, "hab. ad rupes vulcani prope Cabondo, tempore pluvio, Feb. 1857," was no doubt *Nostoc commune*; and to this species might also be referred No. 22, found "ad rupes."

Cystoliths in Leaves of Gymnostachum *and* Fittonia.—Mr. Greenwood Pim showed sections of the leaves of *Gymnostachum* and *Fittonia*, in which were remarkable cystoliths, hitherto unrecorded from these genera, although met with in other allied Acanthaceæ. These bodies were rounded oblong in shape, slightly tubercular, and apparently destitute of any suspensor (as in *Ficus elastica*), and of cellulose basis, as dilute nitric acid dissolved them almost entirely, leaving a scarcely perceptible residuum. They were much larger than the cells of the parenchyma of the leaf, in which they occupy intercellular spaces. There appeared but little, if any, specific distinction between the leaves of *Gymnostachum Verschaffeltii* and *Fittonia argyroneura*, the two species exhibited. Subsequent examination of some half dozen of the forms of Acanthaceæ showed very similar bodies in all but one genus, *Aphelandra*. The other genera in which Mr. Pim observed these were *Justicia*, *Thyrsacanthus*, and *Adhatoda*, those of the last named being longer and more clavate than in the other forms.

Dr. Zimmermann's Preparations of Fungi.—Dr. M'Nab showed some examples of Dr. Zimmermann's preparations of minute fungi, remarkable for the skill arrived at and success attained in preserving these delicate objects.

Cosmarium isthmochondrum, Nordst., *new to Ireland.*—Mr. Archer showed *Cosmarium isthmochondrum*, Nordst., from Connemara, new to Ireland. This was, in unison with Nordstedt's experience in Sweden, found in company with another rare species, *Cosmarium quinarium*, Lundell; and, if carelessly viewed, the two species might be confounded, as Nordstedt remarks. But they are very distinct things; indeed, once their differences are grasped, they could readily be distinguished, even under the lowest power. The conspicuous and rather large and prominent papilla immediately over the isthmus on each front surface of each semicell is a marked feature of the form in question (*Cosmarium isthmochondrum*), and one very readily seen. There could be no doubt that both the forms entirely agree with those of Sweden. They are both very rare in Ireland. As yet *C. quinarium* has not turned up in the east; it extremely sparingly presents itself in Westmeath; but now and again in spots a somewhat copious gathering may be made in Connemara; it is more rare in the south-west.

February 19, 1880.

A Verticillium *on* Polyporus versicolor.—Mr. Pim showed a species of *Verticillium* which grew in great quantities on decaying *Polyporus versicolor* on stumps in a cold fernery at Monkstown. As he could not satisfactorily determine the species, he sent specimens to the Rev. J. E. Vize, who said he believed it to be *Polyactis vera.* Mr. Pim, however, thought it rather a true *Verticillium,* most probably *V. epimyces,* B. Br.

Structure of Siphon of Mya arenaria.—Prof. H. W. Mackintosh exhibited two sections of the siphon of the common Lamellibranch *Mya arenaria,* one being median, the other distal. Both showed a large amount of muscular tissue, the circular fibres being few in the median, but well marked in the distal part. The septum between the two tubes was composed of a band of connective tissue, which at each end radiated out and formed a network, enclosing in its meshes the bundles of muscle. At each extremity of the septum were placed a large blood-vessel with a nerve on each side. The external surface was composed of a layer of epithelium containing large masses of black pigment-cells corresponding to the periostracum; outside this was a layer of gelatinous substance presenting a stratified appearance, most probably consisting of mucus. The distal section showed that the siphonal tentacles began as processes of the walls of the tubes, which became longer as the orifice was approached. Their first beginnings could be detected some distance down in the tube. Both Rutherford's carmine and Ranvier's picrocarmine had been used; but the former gave the better results.

Sections of Calculi.—Mr. B. Wills Richardson exhibited two sections of calculi: one was an excellent specimen of oxalate-of-lime calculus, and probably had its source in the kidney; the other was one of several passed at intervals, and evidently came from the prostate, the symptoms pointing to that origin. The sections were made by Mr. Baker of London. The longest diameter of the oxalate-of-lime calculus was $\frac{1}{4}$ inch, and of the phosphate-of-lime $\frac{3}{16}$ inch.

Staurastrum brasiliense, Lundell, *new to Ireland.*—Mr. Archer presented examples from Connemara (two only, all he had seen) of that noble form, *Staurastrum brasiliense,* Lundell, non Nordstedt. Lundell, in the text, gives expression to the supposition that this fine species, as regards the arrangement of the endochrome, presented a state intermediate between the central and parietal mode, or rather, as it were, uniting those two types. Mr. Archer had satisfied himself, on getting a good end view of a quite fresh example, that such is not the case, as the endochrome radiates in double plates from the centre towards the angles—in a word, agreeing with the type presented by the majority of *Staurastra,* and not at all with the parietal arrangement, such as occurs in *S. tumidum* &c. Mr. Archer could hardly acquiesce in the opinion that

Nordstedt's Brazilian species could be truly the same as the Swedish and Irish one, which were precisely identical; the former is smaller, and cannot be at all so noble an object. At first glance so fine a thing is most striking; and when first noticed, Mr. Archer, attracted by the three conspicuous spines at the angle, was momentarily under the impression that he had encountered *S. Royanum* in Ireland, itself a large and fine species, but still a good deal smaller than *S. brasiliense*; but a second glance showed the mistake, and *S. Royanum* still remains undetected out of Glencoe, in Scotland; nor did a search there on the occasion of a visit in the autumn of 1880 redisclose it.

April 16, 1880.

Pandorea Traversii, J. Ag.—Prof. E. Perceval Wright showed a preparation of *Pandorea Traversii*, J. Ag. species, for which he was indebted for specimens to Prof. J. G. Agardh. It seems to show some interesting points of resemblance between the structures long since described to the Club in the young growing fronds of *Griffithsia setacea* by Dr. Wright.

The "puncta" distributed over the smooth cell-walls of Desmidieæ *are really pits or depressions, not thickenings or points different in tint from the rest of the membrane.* -Mr. Archer brought under notice some empty cell-walls of *Cosmarium pyramidatum* and some other Desmidieæ, in order to draw attention to the "puncta" or dots covering the superficies, with a view to show that these puncta are really depressions or pits, not either mere darker, or brighter, or thicker points of the wall or membrane. Whether these depressions might not sometimes represent tubules passing right through, he would leave in abeyance. That they really indicate hollows or pits is, in minute forms very "finely punctate," somewhat difficult of verification; but on looking over a series of the "smooth" forms, as the puncta become more and more "coarse" the fact seems very readily made out, until in such large forms as the larger *Euastra* they appear, especially on the inflated prominences, decided minute cup-like hollows. It may be, indeed, that these pits may present the appearance of having become filled with some more solid substance, like a kind of excretion through such openings, giving some forms a pseudogranulate aspect. May it be possible that the radiating lines noticeable in the enveloping mucous investment of many of such forms stand in direct connexion with these "puncta"? and may such lines represent tubules carried on through such mucous coat? Forth from these radiating lines or striæ in the mucus, which naturally stand vertically to the superficies of the cell-membrane, it is that "*Bacterium*-like" (to be no more precise) bodies may sometimes (though the occasions are rare) be seen to issue, and all the more readily on application of some pressure on the covering-glass, and then slowly totter off—a fact that probably has not been generally noticed. The nature of the puncta and markings in general on the Diatoms has often been the subject of dispute; but no one seems to have paid much attention to test what the nature of the puncta in the Desmids is, which was Mr. Archer's apology for bringing forward the subject on the present occasion.

Advantages of Double Staining with Logwood and Eosin.—Dr. R. J. Harvey showed an ordinary typical specimen of epithelium as illustrative of the advantage to be derived in some cases by double staining with logwood and eosin. The staining by the logwood was confined for the most part to the connective-tissue elements, which were of a rich blue-purple, whilst the epithelium was stained a most brilliant rose-red by the eosin. The epitheliomatous nests made thus a most striking contrast with the surrounding sarcomatous structure.

May 20, 1880.

Trachelomonas bulla, *T. volvocina, and a new very hispid form.*—Mr. Archer showed living examples of a few Flagellata belonging to *Trachelomonas*—*T. bulla*, *T. volvocina*, as well as a very hispid and ornate form, probably a new species. This was a large form, the spines fore and aft long and numerous; neck rather long, and margined by a few rather long spines; the body egg-shaped, and bordered by a number of shorter spines; internal colour vivid green; eye-speck brilliant; motion fidgety, but active. This is probably the prettiest and most ornate of the pretty forms appertaining here, and might stand as *Trachelomonas acanthophora*, n. sp.

Ramularia cryptostegiæ, n. sp., Pim.—Mr. Greenwood Pim showed *Ramularia cryptostegiæ*, Pim. This form, according to Dr. Cooke, who examined the specimen, is a new species, and is described under the above name in the current number of 'Grevillea.' The threads are more developed than in the other species of the genus; spores large, oblong, and very numerous, with one to three very delicate septa. The plant grew on seeds of a *Cryptostegia*, sown in a small pot in Mr. Pim's stove at Monkstown. Mr. Pim also drew attention to the fact that he had been able, by the use of alcohol and glycerine jelly, to mount Moulds more satisfactorily than by using other methods previously tried. Doubtless it was in this way that the exquisite preparations by Dr. Zimmermann, shown by Dr. M'Nab at a previous meeting of the Club, were mounted.

Structure of Arms of Rossia macrosoma.—Prof. H. W. Mackintosh exhibited a transverse section of one of the arms of the Cephalopod *Rossia macrosoma*, which showed a large central nerve occupying the axis of what appeared like a canal, the rest of the cavity of which was filled with a crystalline substance, probably sodium chloride; outside this was a well-marked layer of connective tissue, sending out bands between the bundles of longitudinal muscles which formed the bulk of the intermediate part of the arm. These bands again united to form a second sheath, external to which was another stratum of muscle, both longitudinal and circular, with nerve-branches through it. This stratum graduated insensibly into the many-layered integument. There were bands of circular muscle in the inner sheath of connective tissue; but no vessels could be observed.

Problematical Vegetable Growths.—Dr. E. Perceval Wright exhibited two forms of vegetable growth which had made their appearance in bottles of salt water in which *Bryopsis plumosa* had been kept growing over the winter. One of them was evidently a fungal form, giving rise to immense masses of hyphæ, with at intervals large groups of conidia; this form chiefly grew under the water. The other, apparently a chlorophyllaceous form, was to be met with just on the margins of the water, and growing up towards the cork, in air. It was marvellously polymorphic in the outline of its cells, which, at one time connected to form irregular filaments, at another separate, differed so much in shape from one another as to make it a matter of difficulty to find half a dozen alike. There did not seem to be any organic connexion between the two. Small morsels of the hyphæ, when placed on a morsel of orange, fructified, and were apparently to be referred to *Mucor mucedo*; but the specimen got spoilt before this point could be authoritatively decided. The green algæ continued to grow, forming little fluffy tufts.

Zygospores of Xanthidium Robinsonianum, *Archer, exhibited for the second season.*—Mr. Crowe presented zygospores of *Xanthidium Robinsonianum*, Archer, quite bearing out, when fully developed, their characters of last year. These examples were taken at the same locality in co. Kildare.

Staining of Spinal Cord of Bullock.—Mr. B. Wills Richardson exhibited a cross section from the lumbar portion of the spinal cord of a bullock, stained in three colours, viz. carmine, picric yellow, and lilac. By daylight the three tints were very distinct; but by ordinary paraffin lamplight the picric yellow and the lilac could scarcely be seen. However, by placing a piece of blue glass beneath the slide, the picric yellow could then be distinguished. The section was mounted in Klein's damar solution.

Aniline Blue and Logwood Staining.—Dr. Harvey showed two specimens illustrative of a new method of staining with aniline blue-black and logwood. The blue-black is dissolved in ½-per-cent. solution of alum, and mixed with the ordinary aqueous solution of logwood chips in about the proportion of three to one. The first preparation was a specimen of the interauricular system from the heart of a frog, showing the pneumogastric nerves and intrinsic ganglia *in situ*. It was mounted in glycerine. The second was a transverse section of the lumbar portion of the spinal cord of a child. It was mounted in damar. Dr. Harvey stated that he had got much better results by the use of this method than by the use of either dye separately.

Cosmarium Wittrockii, Lundell, *new to Ireland (probably new to Britain).*—Mr. Archer exhibited, for the first time noticed in Ireland, he believed in Britain, *Cosmarium Wittrockii*, Lundell, a minute but pretty little species that might easily enough be overlooked.

BIBLIOGRAPHICAL NOTICES.

A History of the Birds of Ceylon.

By Captain W. Vincent Legge, R.A. London, 1880. 4to.

This work, of which the first part was issued in November 1878, has been completed by the publication of part 3, in September 1880. It consists of nearly 1300 closely printed pages in 4to, and is illustrated by 34 coloured plates, a map, and several woodcuts. All the leisure time which the author could spare from his military duties during a residence of eight years and a half in Ceylon, and the incessant labour of three other years after his return to England, were devoted to its preparation.

Yet, voluminous as the work is, it includes accounts of 371 species only of the fauna of Ceylon; and it is therefore evident that the author had a great deal to say upon his subject, and that in its treatment he relied rather on his eye and pen than on the skill of his artist. In fact, the book bears on every page the stamp of being written by a man who combined the method of the systematic student with the experience of the field-naturalist. The author's object was not only to produce a scientific account of the birds of the island, but to write it in such a manner as to render its contents acceptable to the educated class of the inhabitants, and to inspire them with a taste for the study of birds. In both respects he has succeeded so well that, without hesitation, we can commend the work as a pattern to all faunistic workers. The plates belong to the best productions of M. Keulemans, and represent the species peculiar to the island.

As regards the arrangement of the text, the article on each bird is composed of six parts, viz. synonymy, description, observations, geographical distribution, habits, and nidification. The descriptions go considerably beyond the limits of a diagnosis, yet are as concise and generalized as the variations of plumage of the species will admit. The "observations" are given chiefly for the benefit of the local student, and furnish collateral information as to continental specimens of the same species, or as to other species representing the Ceylonese types in India or elsewhere. The geographical distribution is worked out in a very elaborate manner, and must have cost the author immense labour, on account of the number of works which he had to consult critically. The distribution within the island, the habits, and nidification are based chiefly upon the author's own observations. Only, owing to the difficulty of observing the birds on their nests, and of obtaining reliable information, he has had to avail himself of the assistance gathered from A. Hume's works on Indian oology, though he obtained many original notes from a valued correspondent, Mr. Parker. As regards that incubus of every ornithological work, the synonymy, the author, very properly, has limited his references to the most important publications, paying particular attention to those which contain local information on the occurrence of a species in Ceylon. For the author found Ceylonese ornithology not an entirely uncultivated field of the Indian fauna. Besides Blyth, whose labours now possess rather an historical interest, Mr. Layard and Mr. Holdsworth had made most important contributions to our knowledge of the birds of the island—the former adding not less than 110 species to the lists previously published, and supplying valuable information on their habits, in a paper which he contributed to the pages of this journal nearly thirty years ago; whilst the latter supplemented Layard's list by 24 species, thus bringing the total number of Ceylonese birds to 326, in a carefully edited paper which appeared in 1872 in the 'Proceedings of the Zoological Society.' As mentioned in the beginning of this notice, Captain Legge enumerates 371 species; of these, two Finches are known to have been introduced, and eighteen other species rest upon doubtful evidence*. Forty-seven species prove to be peculiar to the island, as are also the two genera or subgenera *Elaphrornis* and *Sturnornis*. The majority of these species are nearly allied to hill-forms of the continent of India and Malayasia; and two crested Eagles of the genus *Spizaetus*, with the peculiar species of Flycatchers, Bulbuls, and Babbling Thrushes, represent closely allied forms inhabiting the Himalayas and Nilgherries. The author considers that the avifauna of Ceylon, taken as a whole, is very closely allied to that of the southern portion of the peninsula of India—a conclusion which fully agrees with our present knowledge of the Reptilian fauna. He further points out that in the hill-regions of the countries where the rainfall is similar, the near affinity of the species is remarkable. The low-lying portions in the north of the island possess a similar avifauna to that of the Carnatic, and from that direction receive a cloud of migrants in the cool season.

Although the fauna of an island which, like Ceylon, is in close proximity to a continent does not possess that intense interest which attaches to that of oceanic islands, it is nevertheless of the highest importance to Biology that the fauna of a district with such defined limits should be worked out completely and in detail, in order to enable the students of future generations to perceive and appreciate those changes which, as we know, are constantly taking place in the distribution, habits, and characteristics of the species. Therefore the importance of this work is to be measured not only by its value to the specialist of the present day, but no less so by the help it offers with respect to those wide biological questions, the solution of which depends on conscientious and accurate records like those contained in the present work.

A Monograph of the Free and Semi-parasitic Copepoda of the British Islands. By GEORGE STEWARDSON BRADY, M.D., F.L.S. 3 vols. 8vo. London, Ray Society, 1878–1880.

IT is, perhaps, hardly necessary in these pages to say any thing in general praise of the Ray Society or of the admirable series of works that it has produced. Since its establishment in 1844, British naturalists, and especially zoologists, have had to thank the Ray Society for so many splendid monographs, that its activity must be familiar to every one; and we can only regret that an organization which has effected so much should appear to be languishing for want of well-merited support. The last publication of the Society, the title of which stands at the head of this notice, fully maintains the high reputation which has been gained by former productions, and will be welcome to many workers.

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* One of these, *Schœnicola platyura* deserves to be included in the number of Ceylonese species, as a specimen in the British Museum is of undoubted authenticity, and its claim to this fauna is at least as strong as that of *Neophron ginginianus*.

Some thirty years ago, in the time of its early youth and vigour, the Ray Society published a 'Natural History of the British Entomostraca,' by the late Dr. William Baird, a work which embodied all that was known at the time of the Entomostracan Crustacea inhabiting these islands. At that date, however, comparatively little attention had been paid to these denizens of our shores and fresh waters; and, indeed, the information given by Dr. Baird was, to a very great extent, accumulated by his own personal labours. With his book as a guide the investigation of the Entomostraca became a much easier matter than before, and the number of students who paid some attention to them naturally increased. At the same time dredging-operations were more systematically carried on; and new materials were thus constantly being brought to light, increasing enormously the number of known forms which might fairly be regarded as British.

Moreover the zoologists of other countries have not been idle; and, in fact, they have done more in the way of describing new generic and specific types than those of Britain; so that the literature of the Entomostraca has of late years been greatly increased, especially at the hands of Scandinavian naturalists. In the work now under consideration Dr. Brady describes the British genera and species of the order Copepoda as limited by Baird—that is to say, the free and semi-parasitic forms, leaving out of consideration the truly parasitic types regarded by many recent zoologists as Copepods, with which, indeed, they are directly affiliated by their developmental history.

Some notion of the progress that has been made in the study of these little creatures may be formed from a mere comparative statement of numbers. Baird, writing thirty years ago, recognized only 13 species of Copepoda; Dr. Brady in his present work describes 151. It is true that a certain proportion of this addition may be due to the recognition of specific diversity where unity was formerly supposed to prevail, as is strikingly shown in the case of the genus *Cyclops*, in which, while Baird admits only the single species *C. quadricornis*, Dr. Brady describes 14 species; but it must be chiefly ascribed to the discovery of new forms, especially among the inhabitants of the sea and brackish waters.

In his treatment of his subject Dr. Brady adopts the division of the Copepoda into three great sections, as proposed by Thorell, namely:—Gnathostoma, with a pair of mandibles and three pairs of maxillæ; Pœcilostoma, with no mandibles, but with from one to three pairs of maxillæ; and Siphonostoma, with a siphonate mouth usually including the mandibles, and either destitute of maxillæ, or furnished with such organs up to three pairs. This arrangement has been rejected by Claus; and the structure of the mouth in the second group does really appear to be so exceedingly obscure as to render it somewhat problematical. Dr. Brady, however, discusses the question at some length (vol. iii. pp. 27–29), and gives his reasons for adhering to Thorell's classification. The name Siphonostoma seems to be unhappily chosen for the third division, as it was applied to a different nearly allied group by Latreille, and adopted by many later writers, including Dr. Baird. Hence its use in the above sense can only lead to confusion.

Of course much of the increase in the number of species above referred to is due to the minute analysis of characters which has come into vogue within the last twenty or thirty years; and owing to the same cause the number of genera recognized has been augmented to the fullest possible extent. The 151 species described are referred to no fewer than 67 genera; and, making every allowance for the fact that many of these genera undoubtedly include other species not belonging to the British fauna, we may, without criminal scepticism, feel doubtful whether the progress of science is favoured by such minute subdivision. No doubt there are many cases in which genera, and even subfamilies and families, must be founded for the reception of single species; but the excessive splitting-up of genera and higher groups is the weak point of modern zoology. Analysis is the one thing needful according to the present zoological creed; and as it is far more easily carried out, or rather can be carried out without the possession of any special fitness for the task, whilst the attempt at a synthetical view of the classification of animals calls for certain natural qualifications which every one does not possess, we may expect to see the analytical method in natural history flourish exceedingly, especially in the hands of the rising generation of school-taught professional naturalists.

Returning from this digression, we may say that Dr. Brady's book furnishes evidence in every page of the most careful work. A short outline of the general anatomy and development of the Copepoda is given by him in his third volume; and in the introduction to the first he discusses the general classification of the group, concluding with excellent tabular synopses of the families and genera, which will prove most useful to the student. The more detailed characters of the various groups and species are evidently drawn up with the greatest care; but only the more important synonyms of the latter are given in the case of those old-established species which have necessarily been frequently described by previous authors. The distribution of the species is carefully indicated. The illustrations consist of an immense number of figures of the entire animals and of their characteristic parts, occupying no fewer than 93 plates. These figures, which are nearly all in outline, have been drawn by the author himself, and admirably put on the stones by Mr. Hollick. In fact, both as regards the text and the illustrations, this is a work of which both the author and the Ray Society may be justly proud. Although not so showy as some previous publications of the Society, it is a book of sterling value, and one that will be of the most essential service to the student of British zoology.

MISCELLANEOUS.

Notes upon the Food of Predaceous Beetles.

By F. M. WEBSTER.

PLINY thought it nothing to the credit of the philosophers of his day that while they were disputing about the number of heroes by the name of Hercules, and the site of the sepulchre of Bacchus, they should not have been able to decide whether or not the queen-bee possessed a sting*.

While the problem of the bee-sting has long been decided, and heroes by the name of Hercules have ceased to trouble the minds of men, there are problems of vital importance regarding the habits of the insects which, during the greater portion of the year, we meet daily in abundance, that still remain unsolved.

The most important as well as the most abundant of these insects are the beetles.

While found in almost every conceivable situation, while our naturalists count the species in their cabinets by thousands, it would be difficult to point out a single species the food-habits of which we *fully* understand, when both the larva and imago state are taken under consideration.

True, we have a sort of ritual laid down by entomologists, based upon the fact that certain species have been known to feed upon certain substances; but this can no more be considered as proof that nothing else enters into their natural diet, than does the meat of which we may partake at dinner prove us to be strictly carnivorous, or the bread or fruit, that we are exclusively vegetarians.

An illustration of this double diet of beetles is found in the case of the European *Silpha opaca*, Linn., the larva of which has been known to feed to an injurious extent upon the leaves of the beet and mangel-wurzel†.

But one of the most fortunate in getting the benefit of our ignorance is the family Carabidæ, to utter a word against which is almost considered a sacrilege.

But, true to the adage "murder will out," occasionally a species is found feeding upon vegetation with a voracity that would do credit to a Chrysomelid. Of these in Europe, besides the *Zabrus gibbus* in both stages, some species of *Pterostichus*, *Amara*, and *Omophron*, and *Calathus latus*, Westw., are said to injure grain by eating off the young shoots or destroying the seed‡.

Two species of *Bembidium* (*lampos* and *monticola*) have been destructive to the forests of Upper Austria§.

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* Plin. Hist. Nat. l. xi. c. 17.

† Curtis, 'Farm Insects,' p. 388.

‡ Report U.S. Agr. Dep. 1868, pp. 79, 80.

§ Deutsche entomologische Zeitschrift, 1879, p. 17.

Broscus cephalotes attacks the growing grain; and *Aristus bucephalus* devours the seeds of grass[*].

In our own country the *Omophron labiatum*, Fab., injures the shoots of young corn in the Southern States.

Harpalus caliginosus, Fab., is suspected of feeding upon grain in stack in Maryland, and also of eating timothy seeds from the heads[†].

E. T. Dale, of Jasper, Mo., forwarded to the editors of the 'American Entomologist' specimens of an insect found by him feeding upon the seeds of a plant unknown to him. Upon examination they proved to be *H. caliginosus*[‡].

According to Mr Mather, of Marshalltown, Iowa, the larvæ of some species of *Harpalus* are destructive to his evergreens, he having found them eating off the roots[§].

The foregoing is a synopsis of all facts relating to the vegetable-feeding Carabidæ, so far as known to the author of this paper. A number of years ago the writer commenced the study of the food of beetles, correctly judging, from what was then known, that either naturalists were in error in their suppositions, or else that innocent insects were wrongly accused. And he is free to confess his partiality to the former theory as being the most correct. But after several years of study and observation, I have found to my astonishment not only the species accused but others also of this family feeding largely upon vegetable substances, both useful and noxious. Among my earliest observations upon this subject I noted the abundance of Carabidæ about the shocks of wheat in a field where a violent wind-storm had blown down a large number of sheaves, under which, upon their being replaced, large numbers of *Harpalus caliginosus*, *pennsylvanicus*, and *herbivagus*, *Pterostichus lucublandus*, and *Anisodactylus baltimorensis* were observed.

The wheat was drawn in and threshed directly from the field; and a large percentage of the kernels were badly eaten. Previous to the threshing, in another field, a specimen of *H. pennsylvanicus* was captured with a partially eaten grain of wheat in its mandibles. The eaten grains of the threshed wheat seemed to agree with the fragments found in the jaws of the beetle; and as no other destructive elements were noted, the facts seemed to suggest that the damage was done by the before-mentioned Carabidæ. A few days after, *H. pennsylvanicus* was found eating the now fully ripe seeds from a head of upright timothy grass, and was observed to detach them from the glumes. The same species has since been seen feeding largely upon rag-weed (*Ambrosia artemisiæfolia*, Linn.) during September, the seeds apparently being the favourite part. A short time after it was found upon timothy grass, it was observed eating the seeds of prairie-grass (*Panicum crus-galli*, L.); and the same day another individual was found devouring an *Ips fasciatus*, Oliv., one of the Nitidulidæ, thus proving its carnivorous propensities also.

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[*] Westwood's Introduction, i. p. 61.

[†] Report U.S. Agr. Dep. 1868, p. 80.

[‡] Am. Ent. o. s. vol. i. p. 80.

[§] Am. Ent. n. s. vol. i. p. 26.

H. caliginosus is likewise found eating the seeds of *Ambrosia artemisiæfolia.*

H. herbivagus feeds largely upon the tender shoots of grass during March, cutting them off just below the surface; but later it selects the tender blades and the discoloured parts usually found under boards, &c.

Amara angustata, Say, is found quite abundantly upon the heads of June grass (*Poa pratensis*, L.). But the most voracious Carabid enemy of this grass is the *Anisodactylus sericeus*, Harris.

Early in June 1878 vast numbers of these beetles were noted upon the heads of this grass; in fact, spots several yards in area were literally covered with them. After patient watching (for they are very timid) the proof was conclusive that the unripe seeds were what they were after, and not microscopic insects, as was at first supposed.

The insect is not only cunning, drawing up its legs and dropping to the ground upon the least disturbance, after the manner of a Chrysomelid, but also shows considerable ingenuity. It grasps the lower extremity of the glume tightly in its mandibles, then relaxing slightly, passes upward and again tightens its grasp—a series of movements which finally force the seed, which is now of the consistency of cream, out at the apex. This it at once proceeds to devour with an appetite which reminds one quite forcibly of a tramp who has been obliged to earn his dinner in advance. Later in the season it is found feeding in the same manner upon the seeds of *Agrostis vulgaris*, Witt. Specimens of *Anisodactylus baltimorensis*, Say, were observed feeding upon the marrow and fatty matter clinging to the tibia of some dead animal, probably that of an ox. Attention is called to this as being in perfect accord with microscopic observations reported by Mr. Forbes upon another specimen found upon grass a few months later.

Calathus gregarius, Say, may be found abundantly upon the heads of timothy grass during the early mornings of the beginning of July. Of the genus *Platynus* only a single observation has been obtained; and this was during the latter part of June of the present year, when two specimens of *P. cupripennis*, Say, were seen harassing a half-grown cricket, which they had already disabled. The carnivorous habits of beetles are often as difficult to discover as their vegetarian. Usually they are not at all in favour of public dinners, and, like beasts or birds of prey, prefer to drag their victims to some secluded nook to devour them; hence if the observer gets any insight into this part of their domestic affairs, he must take them by surprise. In this manner a *Staphylinus cinnamopterus*, Grav., was surprised while in the act of devouring an *Anomoglossus pusillus*, Say, having first, to guard against its escape, eaten off four of its legs.

In another instance, a *Dyschirius globulosus*, Say, was observed to spring upon a small salmon-coloured maggot-like larva, and, after disabling it, to start off to select a proper place to devour it. After the lapse of several minutes it returned to drag its victim under a small clod of dirt and leisurely feast upon it.

After the same manner a *Bradycellus rupestris*, Say, was surprised under a stone while eating a small white thread-like worm.

Another family of beetles whose hitherto almost untarnished reputation it seems to have fallen to my lot to soil is the Coccinellidæ. With the exception of *Epilachna borealis*, Fabr., the larva of which feeds upon the vines of the gourd family*, these insects in our country have been considered strictly carnivorous, although several European species are known to deviate from this rule.

This season, specimens of *Megilla maculata*, Deg., have been taken while feeding upon the pollen of the dandelion (*Taraxacum dens-leonis*); and it is not at all improbable that the pollen of other plants also forms a part of their diet, as they are rather common upon the blossoms of plants and fruits.

No accurate estimation of the value of the Coleoptera could be obtained without including the Telephoridæ. Besides *Chauliognathus pennsylvanicus*, Forst., which has been found feeding upon the larvæ of the *Conotrachelus nenuphar*, Hbst. †, and *Telephorus bilineatus*, Say, which is such a powerful auxiliary in checking the ravages of the western locust ‡, *Podabrus tomentosus*, Say, has been observed feeding upon the cotton-wood gall-lice, *Pemphigus populivenæ*, Fitch, and *P. populicaulis*, Fitch. These beetles sometimes place themselves at the opening of the gall, occasionally as many as four together, and catch the mature lice as they attempt an egress, and sometimes plunge their flat head and thorax into the cavity and draw forth and devour large and small indiscriminately. During the latter part of June and the beginning of July these beetles are very abundant, not only upon trees affected by gall-lice, but upon other plants also.—*Illinois State Lab. of Nat. Hist.*, Nov. 1880.

Giant Squid (Architeuthis) *abundant in* 1875 *at the Grand Banks.*

By A. E. Verrill.

From Capt. J. W. Collins, now of the U.S. Fish Commission, I learn that in October 1875 an unusual number of giant squids were found floating at the surface, on the Grand Banks, and mostly entirely dead and more or less mutilated by birds and fishes. In very few cases they were not quite dead, but entirely disabled. These were seen chiefly between N. lat. 44° and 44° 30′, and between W. long. 49° 30′ and 49° 50′. He believes that between twenty-five and thirty specimens were secured by the fleet from Gloucester, Mass., and that as many more were probably obtained by the vessels from other places. They were cut up and used as bait for codfish. For this use they are of considerable value to the fishermen. Captain Collins was at that time in command of the schooner 'Howard,' which secured five of these giant squids. These were mostly from 10 to 15 feet long, not including the arms, and averaged about 18 inches in diameter. The arms were almost always mutilated. The portion that was left was usually from 3 to 4 feet long, and, at the base, about as large as a man's thigh.

One specimen, when cut up, was packed into a large hogshead tub, having a capacity of about 75 gallons, which it filled. This tub was known to hold 700 lbs. of codfish. The gravity of the *Architeuthis* is probably about the same as that of the fish. This would indicate more nearly the actual weight of one of these creatures than any of the mere estimates that have been made, which are usually much too great. Allowing for the parts of the arms that had been destroyed, this specimen would, perhaps, have weighed nearly 1000 lbs.

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* Am. Ent. o. s. vol. ii. pp. 12 & 373.

† Am. Ent. o. s. vol. i. pp. 35 & 51.

‡ Report U.S. Ent. Com. vol. i. p. 302.

Among the numerous other vessels that were fortunate in securing this kind of bait, Capt. Collins mentioned the following:—The schr. 'Sarah P. Ayer,' Capt. Oakly, took one or two. The 'E. R. Nickerson,' Capt. M'Donald, secured one that had its arms and was not entirely dead; so that it was harpooned. Its tentacular arms were 36 feet long. The schr. 'Tragabigzanda,' Capt. Mallory, secured three in one afternoon. These were from 8 to 12 feet long, not including the arms. These statements are confirmed by other fishermen, some of whom state that the "big squids" were also common, during the same season, at the "Flemish Cap," a bank situated some distance north-east from the Grand Banks.

The cause of so great a mortality among these great Cephalopods can only be conjectured. It may have been due to some disease epidemic among them, or to an unusual prevalence of deadly parasites or other enemies. It is worth while, however, to recall the fact that these were observed at about the same time, in autumn, when most of the specimens have been found cast ashore at Newfoundland, in different years. This season may, perhaps, be just subsequent to their season for reproduction, when they would be so much weakened as to be more easily overpowered by parasites, disease, or other unfavourable conditions.—*Amer. Journ. Sci.*, March 1881.

On the Histolysis of the Muscles of the Larva during the Postembryonic Development of the Diptera. By M. H. Viallanes.

It has long been known that all the muscles of the larva of the fly disappear at the moment when the insect passes into the pupa state; but no observer seems to me to have studied the phenomena which accompany this disappearance, known under the name of *histolysis*. In my investigations upon this subject I have examined more than 400 sections* made across entire larvæ and pupæ of *Musca vomitoria*, previously fixed by picric acid, hardened by alcohol, and coloured with carmine. To arrive at a correct understanding of the phenomena which characterize the histolysis of muscle, it is desirable, in the first place, to determine exactly the structure of the primitive bundle in the larva. Before the latter has become motionless the primitive bundle, observed in a transverse section, presents a sarcolemma enclosing the contractile mass, which exhibits the characteristic pattern of Cohnheim's areas, and, further, nuclei. Of these, some are situated beneath the sarcolemma, the others in the heart of the contractile mass; it is difficult to distinguish a double contour in them; they are lenticular, pretty strongly coloured red by carmine, and present in their interior some darker granules. From the first day of pupal life the primitive bundles thus constituted begin to disappear, and this according to two different modes, both of which may be observed in the same animal. One of these modes is characterized by the excessive activity and proliferation of the muscular nuclei; the other, on the contrary, by their degenerescence and death.

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* All these sections are preserved.

1. *Disappearance of the Muscle accompanied by Proliferation of the Nuclei.*—In the bundles which disappear in accordance with this mode, the sarcolemma has disappeared even before the envelope of the pupa has acquired its characteristic brown appearance; the contractile substance has become homogeneous; the nuclei, both those situated beneath the sarcolemma and those in the midst of the contractile mass, have become spherical, and acquired the property of being coloured by carmine of a very dark purplish red, which characterizes them. Such a nucleus soon acquires the value of a complete cell; it is surrounded by a layer of protoplasm, which is itself clothed with an enveloping membrane. In this protoplasm are seen four or five spherical granules of a bright rose-colour; these granules enlarge, and soon attain the size of the nucleus, when there is produced a mulberry-like mass composed of five or six grains lodged in a common envelope. One of these grains, the true muscular nucleus, is of a purple-red, while the others are bright rose-colour. The membrane soon disappears, and the purple and rose-coloured nuclei separate.

This proliferation of the muscular nucleus takes place on the spot; and the contractile substance becomes absorbed around it to lodge these new formations. These light rose-coloured nuclei, the mode of formation of which we have just seen, multiply in their turn by a mode analogous to that which gave them birth. In proportion as the embryonic cells thus produced increase in number the contractile substance is absorbed. In a section the primitive bundle then appears constituted as follows:—The contractile substance, which has become perfectly homogeneous, exhibits a deeply notched sinuous border; these sinuosities are occupied by the embryonic cells, due to the proliferation of the muscular nuclei; and they are deeper in proportion as this accumulation of embryonic cells is more considerable. The central part of the contractile mass appears pierced with holes of irregular outline, filled with embryonic cells due to the proliferation of the intramuscular nuclei.

At a more advanced stage the place that was occupied by the muscular bundle is indicated only by a mass of embryonic cells in course of incessant proliferation.

2. *Disappearance of the Muscle accompanied by the Degenerescence and Death of its Nuclei.*—After the disappearance of the sarcolemma the muscular nuclei appear with a very distinct envelope presenting a double contour; they still retain their lenticular form; their centre is occupied by a small spherule formed of fine granules, which are then the only coloured parts of the nucleus. The granules

which constitute this spherule become fewer and fewer; they seem to separate from each other; and finally they disappear; the nucleus is then represented only by its envelope, which looks like an empty shell. While the nucleus is undergoing these transformations the contractile substance gradually disappears, melting away, so to speak, and this in so regular a manner that the general form of the bundle is not altered. The product of this sort of dissolution seems to be a colourless very finely granular substance, enveloping the portion of the contractile mass that has not yet disappeared. In this granular mass we find the muscular nuclei in their place and in all the degrees of degeneration that I have just indicated.

Thus the muscles of the larva are destroyed at the moment when the latter passes to the pupa state, and this in two quite different modes. In the first case the muscular nuclei, becoming active, proliferate and give origin to a whole swarm of embryonic cells; and these grow and multiply at the expense of the contractile mass, which seems to disappear before their invasion. In the second case the muscular nuclei seem to degenerate and die, while the contractile substance gradually disappears as by a regular solution.—*Comptes Rendus*, February 21, 1881, p. 416.

On a new Form of Segmental Organ in the Trematodes.

By M. E. Macé.

The authors who have observed the ciliated organs in connexion with the vasculo-excretory apparatus of the Trematodes (Thiry, Bütschli, J. Fraipont) have described them in the species that they have studied as little ciliated funnels, often unicellular, each bearing upon a differentiated plate a vibratile flagellum. In studying a small *Distomum* from the intestine of *Vespertilio murinus* we have ascertained the existence of a very distinct conformation.

The ciliated organ is single. It is a pretty large cup situated in the median line towards the posterior third of the body, immediately beneath the transverse vitelloduct. Its diameter is nearly half that of the ventral disk, which is situated a little above it. Its orifice, turned towards the ventral surface of the body, is clothed with a row of long vibratile cilia, which, when they are in movement, give it the aspect of one of the ciliated wheels of certain Rotifera. From this ciliated funnel start four vessels. The two superior are directed upwards, and soon elude observation. The two inferior have a transverse direction; after a short course they open each into the corresponding branch of the great terminal cavity of this apparatus.

This *Distomum* has great analogy with *D. ascidia* of Van Beneden. It differs from it, however, in the place occupied by the vitellogenes. Instead of being in the anterior part of the body, in front of the second disk, they occupy its posterior part. They are two ramified glands in the form of an H, situated below the ovary, against the upper extremity of the two large branches of the excretory vesicle; the transverse vitelloduct passes immediately above the ciliated organ in question, and presents a pyriform dilatation in its median part. The intestine is formed by two wide cæca, which scarcely reach the level of the second disk.—*Comptes Rendus*, February 21, 1881, p. 420.

On the Circulation and Respiration of the Ophiuridæ.
By M. N. Apostolidès.

Having had at my disposal numerous living Ophiurans in the laboratories of Roscoff, the Sorbonne, and Port Vendres, I have been able to apply to these animals peculiar processes of fine injection; and these processes have furnished me with novel results, which I have the honour to communicate to the Academy. My investigations have been made upon the following species:—*Ophiura texturata*, Lam.; *Ophiura albida*, Forbes; *Ophiocoma granulata*, *filiformis*, and *neglecta*, Forbes; and *Ophiocoma rosula*, Johnst.

1. After a successful injection of the aquiferous system, on dissecting the interbrachial space of the madreporic plate, we come upon a dilated whitish canal, rendered rigid by calcareous plates; and on tearing this canal we see, towards the middle, a brownish inflated mass, the supposed heart of authors, on the side of which there is a fillet containing the injected material. This fillet is the sand-canal. This experiment, frequently repeated upon different species, shows that the sand-canal becomes injected at the same time as the aquiferous system, and that the supposed heart is independent of that system; further, the particles of injected material found outside the madreporic plate prove that the sand-canal, extending from the aquiferous ring to that plate, establishes a direct communication between the aquiferous system and the exterior.

2. "*The heart is the true centre of the circulation . . . . it is a plexus of anastomosing vessels which unites the two rings, oral and aboral.*" It is thus that M. H. Ludwig defines the structure and function of the heart. With regard to the two rings, at the discovery of which he arrived by coloration with hæmatoxyline, he admits that he knows "neither their contents nor their structure."

The organ called the *heart* presents very various structures and relations. By a careful dissection it is easy to see that it has an elongated form, and is produced into a rectilinear canal going to the madreporic plate; an injection, forced into the brown mass which represents it, immediately fills this prolongation and appears on the outer surface of the madreporic plate. Its structure, when studied in a heart taken from a living animal, shows that it is a gland with a proper excretory canal opening outward, and not an organ of circulation. On each side of this hitherto misunderstood gland we see two small fibrous bands, directed laterally towards the base of the arms; they become vividly coloured by hæmatoxyline, like the analogous bands which sustain the Polian vesicles; but the liquid injected into the heart never went in their direction.

3. An injection forced between the integument and the digestive tube (that is to say, into the general cavity) never shows itself externally, and never penetrates into the aquiferous system. The general cavity is therefore entirely closed; it is formed of a widened portion surrounding the digestive tube (*peristomachal space*), which

contracts at its upper part to lodge the ambulacral ring, and sends a flattened prolongation to the dorsal surface of the arms (*dorsal space*). Within the aquiferous ring we find the nervous band forming a complete ring around the œsophagus. To find this we have to tear a membrane which envelops it and separates it from the general cavity; then we see the injection which fills the space situated beneath it and surrounds the nervous system (*perinervous space*). If, now, we make a section of an arm, we find in the lower part a furrow hollowed out in the discoidal ossicle, and which contains the ambulacral canal and the brachial nerve. This latter, flattened and bent into a crescent-like form, is in contact with the canal by its thin margins, and thus bounds a rounded space independent of the cavity which surrounds it (*radial space*). What are the relations of the perinervous space and of the radial space to the general cavity? Around each ambulacral canal going to an arm there is a space hollowed out in the calcareous pieces and connected with the general cavity; in the same way, around every nerve issuing from the ring there is a space communicating with the envelope of the band. Now these two spaces advance to meet each other, at the same time as the parts which they contain, and unite at the level of the furrow, thus placing the perinervous space widely in communication with the general cavity. The two spaces unite into one, which occupies the whole cavity of the furrow enveloping the vessel and the nerve (*peripheral space*), and occupying the circular interspace between these two organs (*radial space*). Lastly the general cavity communicates with the incrusted envelope already indicated as surrounding the sand-canal and the heart, which was long regarded as the sand-canal itself (*stone-canal* of authors).

These observations show that no system of proper canals exists, but spaces in close connexion with the general cavity.

On observing a living animal from the dorsal side we see its body swell up and collapse alternately; if we turn it over in a liquid containing coloured particles we see a double current around the genital slits. By injecting a coagulable liquid through one of these slits we find that the orifice gives access to a large, closed sac, dilated in its ventral region, contracted towards the back, immersed in the general cavity, and having on its outer surface the genital utricles. These sacs, first seen by Ludwig, who suspected their function, were nevertheless regarded by him as appendages of the generative organs, and received the name of *pouches*. Experiment, and especially the close relations of the sac with the nutritive liquid of the general cavity, must lead us to consider them true *respiratory sacs*.

From these facts we regard the circulatory system as formed by the general cavity and the spaces connected with it; and we think that the respiratory sacs, by their alternate collapse and dilatation, invite the blood into the peristomachal cavity and afterwards drive it to the periphery. This very simple arrangement explains how the blood, bathing all the organs, respires and is set in motion.—*Comptes Rendus*, February 21, 1881, p. 421.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 41. MAY 1881.

XXXIV.—*Seventh Contribution to the Knowledge of the Fauna of Madagascar*[*]. By Dr. ALBERT GÜNTHER, F.R.S.

[Plate XIX.]

A SMALL collection of reptiles made in the district of Betsileo contains several very interesting novelties, among them again a distinct species of *Chamæleon.* The specific variety of this genus seems to be inexhaustible, and it reminds us in this respect of *Anolis*, although, fortunately, the species are distinguished by more palpable characters.

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[*] The previous contributions are the following:—

1. "Notes on some Mammals from Madagascar," Proc. Zool. Soc. 1875, p. 78.

2. "Notice of two new Species of Mammals from Madagascar," Ann. & Mag. Nat. Hist. 1875, August.

3. "Descriptions of some new Species of Reptiles from Madagascar," *ibid.* 1877, April.

4. "Description of four new Species of Chamæleon from Madagascar," Proc. Zool. Soc. 1879, p. 148.

5. "Description of a new Species of Chamæleon from Madagascar," Ann. & Mag. Nat. Hist. 1879, September.

6. "Description of new Species of Reptiles from Eastern Africa," *ibid.* 1880, September.

Chamæleon O'Shaughnessii, sp. n.
(Pl. XIX.)

This species is allied to *Chamæleon Parsonii*, from which and other similarly armed species it differs in the structure of the skin.

Snout of the adult male produced into two flat compressed high horns, slightly divergent in front, and covered with large scutes; the space between them is broad and deeply concave and covered with rather large shields. Occipital region flat, slanting from behind forwards, with a rounded margin behind, and without lateral flaps. A dorsal crest is indicated by a short row of small pointed tubercles, and ceases entirely before the middle of the length of the trunk. No median series of enlarged tubercles on the throat or abdomen. Skin of the body and tail finely granular, with series of rather large rounded tubercles; similar more crowded and more conspicuous tubercles on the throat. Heel without spur or prominence.

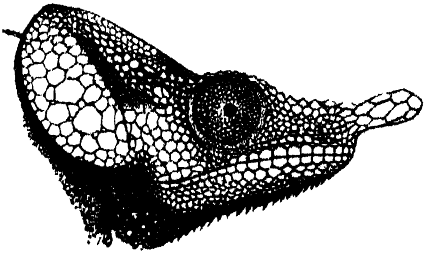
The coloration is now uniform brownish grey, the lower jaw and throat nearly black, with the tubercles yellowish white.

I have seen only one specimen of this very distinct species, from Betsileo; it is an adult male. It is 15½ inches long, the tail measuring 9 inches.

This species is named in memory of my friend and fellow labourer Arthur O'Shaughnessy, who had zealously devoted himself to the study of Lizards, when his useful labours were interrupted by a premature death (30th January, 1881).

Chamæleon brevicornis.

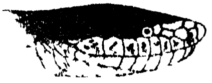
Chamæleon brevicornis, Gunther, Proc. Zool. Soc. 1879, p. 148, pl. xii. fig. A.

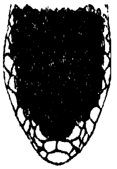


Of this species I have now a series of five male specimens before me, all from Betsileo. The short protuberance of the snout, from which this species takes its name, grows with age:

in an individual 13 inches long the horn is as long as the diameter of the orbit, covered with large smooth scales, and concave above; it is as long as in the specimen of *Chamæleon malthe* figured on pl. xii. of the paper quoted. From that species *C. brevicornis* is readily distinguished by the posterior notch between the occipital flaps and the large scutes covering these flaps. In younger specimens the horn is only half or two thirds of the length of the orbit, or still shorter.

Liophis quinquelineatus, sp. n.





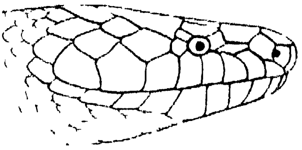
Scales in 21 series. Head short; snout rather pointed; eye small, with round pupil. Rostral shield protruding, extending on to the upper surface of the head; anterior frontals small, one third the size of the posterior; vertical rather longer than broad; occipitals somewhat shorter than vertical and postfrontals together. Loreal short; one præocular, not reaching the vertical; two postoculars. Eight upper labials, the fourth and fifth entering the orbit. Temporals 1 + 2 + 2, the foremost in contact with the lower postocular only. Three lower labials, in contact with the anterior chin-shields. Ventrals 148; anal divided; subcaudals 46. Posterior maxillary tooth strong.

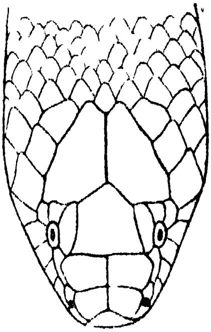
Upper parts brown; a broad margin round the upper jaw brownish yellow, both colours being divided by a sharply-defined line. Two narrow dark lines on each side of the body, and one along the median row of scales on the back. Lower parts uniform whitish.

Two specimens from Betsileo. Total length 17 inches, the tail measuring 3 inches.

Pseudoxyrhopus microps, sp. n.

Jan described under the name of *Homalocephalus* a genus of Colubrine Snakes from Madagascar which he associated with the Coronellines. I am inclined to place it with the larger and more-developed Colubers; and whilst admitting the Snake described by him as the type of a distinct genus, I am compelled to change the name, which is preoccupied in Entomology. The character of mixed (simple and paired) subcaudals must be set aside in the diagnosis of the genus, as a second species (described here) possesses paired subcaudals only.





This second species may be characterized thus:—Scales in 25 series. Head depressed, flat, rather narrow, like that of an *Oxyrhopus*. Snout flat, obtuse. Eye very small. Rostral shield broad, just reaching the upper surface of the head; anterior frontals half the size of posterior; vertical broad, not much longer than broad; occipitals as long as vertical and postfrontals together. Loreal elongate; one præocular, reaching the upper surface of the head, but not the vertical; two postoculars. Eight upper labials, the fourth and fifth entering the orbit. Temporals 1 + 2 + 3, the foremost in contact with the lower postocular only. Four lower labials in contact with the anterior chin-shields. Ventrals 228; anal divided; subcaudals more than 50 (tail injured). Dentition diacrantherian.

Upper parts uniform black, lower whitish.

One specimen from Betsileo. Total length 54 inches, the tail (restored) measuring 8 inches. Feeds on frogs.

XXXV.—*Description of a new Species of Frog from Madagascar.* By G. A. BOULENGER.

Rana guttulata.

Vomerine teeth in two small groups behind the level of the hinder edge of the choanæ. Head depressed; snout short, rounded; loreal region concave; interorbital space as broad as or slightly broader than the upper eyelid; tympanum small, hidden. Fingers rather short, first not extending as far as second; toes rather short, united to the tips by a scarcely emarginate membrane; tips of fingers and toes dilated into small disks; subarticular tubercles small; a blunt, oval, inner metatarsal tubercle. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the eye. Skin granular above, smooth beneath; a fold from the eye to the shoulder; a circular flat gland below each thigh, on its inner side. Dark brown above, minutely dotted with yellowish. Male without vocal sacs.

From snout to vent 123 millims.

Five specimens from Betsileo.

Though the tips of the fingers and toes are swollen into small but very distinct disks, the affinities of this species are not with those of the genera *Hylorana* and *Polypedates* of authors; it should take its place near to *Rana Kuhlii* and *R. Liebigii*. *R. guttulata* is the only Madagascar form of either *Rana*, *Hylorana*, or *Polypedates* which has the tympanum hidden.

XXXVI.—*Supplementary Report on Specimens dredged up from the Gulf Manaar, together with others from the Sea in the Vicinity of the Basse Rocks and from Bass's Straits respectively, presented to the Liverpool Free Museum by Capt. H. Cawne Warren.* By H. J. CARTER, F.R.S. &c.

[Plate XVIII.]

AFTER my "Report" on the specimens from the Gulf of Manaar had been published ('Annals,' 1880, vol. v. p. 437), I received for examination, through my friend Mr. Thomas H. Higgin, F.L.S., of Liverpool, a few more specimens dredged up from the Gulf of Manaar, together with some from the sea in the vicinity of the Basse Rocks off the S.E. coast of Ceylon, and from Bass's Straits, between Australia and Tasmania, respectively, forming the remaining portion of the same collection presented to the Liverpool Free Museum by Capt. H. Cawne Warren in 1879 (viz. bearing the register number "26. 9. 79").

With reference to the specimens from the Gulf of Manaar, which were obtained opposite Tuticorin, and those from the sea in the vicinity of the Basse Roks (all together very few in number), there is little to be said beyond the fact that they present the same facies and are of the same kind as those already noticed (*op. et loc. cit.*); but as they contain a few *new* species as well as a repetition of others already mentioned, it will only be necessary to describe the former here, and give the rest together in a list at the end of the Report.

Among the *new* species is a *Rotalia* which is almost a facsimile of *R. spiculotesta*, but with an *arenaceous* covering, which enables me, in the "Observations," once more to state my reasons for regarding *Squamularia varians* and *S.*

scopula as not only allied, but as furnishing instances of the lowest and least complicated forms of the nautiloid test among the Foraminifera; while the presence of *Gypsina melobesioides*, intercalated with the layers of a *Melobesia* and plentifully accompanied by *Holocladina pustulifera* and *Carpenteria utricularis*, together with a variety of sponges and other minute organisms in small quantities, testifies not only to the great part which the Foraminifera have taken in the formation of many of these so-called "Melobesian nodules," but to the number of beings which have lived on and have become overgrown by the laminæ of which they are chiefly composed, during their progressive formation.

Among the new species of sponges may be mentioned *Cliona Warreni* (so designated to commemorate not only the gift of these valuable specimens, but their having been dredged from the bottom of the sea also by Capt. Warren), together with two new species of Discodermida.

Again, with reference to the specimens from Bass's Straits referred to me for observation, it may be stated briefly that they chiefly consist of calcareous Polyzoa, which have overgrown different kinds of sponges, whose forms they now respectively represent; for in many instances the sponge may be seen inside the case formed by the Polyzoon. Indeed it looks as if these specimens had been dredged from a bed of sponges which had become invaded, overgrown, and thus more or less destroyed by a *colony* of Polyzoa.

Among the sponges, however, there are a few interesting forms which can easily be recognized as *new* species; and these will be described in their proper places:—viz. two which appear to belong to the genus *Axos*, also a *Dictyocylindrus* marked by an unusual development in quantity of the echinating spicule, and a specimen of *Echinonema typicum*, which, together with *E. anchoratum*, from other collections, I have for the first time fully described, having hitherto only mentioned them by name. There are also several specimens of *Dysidea Kirkii*, Bk., an Australian species of my group "Arenosa" among the "Psammonemata," which appears to be exceedingly abundant everywhere on the southern coast of this great continent, although the Bass's-Straits specimens in particular are not very fine; still it has afforded me an opportunity of going into the whole history of *Dysidea*, and of giving a full description of the Australian species from the total number of specimens of the latter that have come under my observation.

It should be remembered, as stated in the first "Report," that all the specimens are dry.

Specimens from the Gulf of Manaar and Basse Rocks.

FORAMINIFERA.

Gypsina melobesioides.

I observe that many of the "Melobesian nodules" in the Gulf of Manaar are chiefly made up of layers of *Melobesiæ* intercalated with *Gypsina melobesioides*, *Holocladina pustulifera*, and *Carpenteria utricularis*; so that, as before stated, the Foraminifera are as much engaged in forming them as the Calcareous Algæ. How far they may be built upon by various kinds of sponges and other organisms afterwards (that is, as they are progressively enlarged by such lamination) must depend a great deal on accidental circumstances; but there can be no doubt that, if ever fossilized, they will each contain a great variety of organic remains. Hence we should not be surprised at finding nodules in the Chalk similarly constituted in this respect.

Rotalia arenacea, n. sp. (Pl. XVIII. fig. 10.)

Test translucent, parasitic, sessile, subcircular, subtrochoid, flat towards the margin. Trochoid portion formed of a spire of nautiloid chambers (fig. 10, *a*), contrasting strongly in its brown colour, as seen through the test, with the flat part (fig. 10, *b*), which *appears* to be without chambers and colourless. Composed throughout of a heterogeneous mixture of minute angular grains of quartz mixed with the remains of microscopic organisms. Size of largest specimen about 1-45th inch in diameter, of which the central half is occupied by the coloured or nautiloid part mentioned.

Hab. Marine, on hard objects; in company with *Rotalia spiculotesta*.

Loc. Gulf of Manaar and Basse Rocks.

Obs. This is almost a facsimile of *R. spiculotesta*, with which it is associated; and but that the test of the latter is formed of calcareous spiculiform bodies produced by the animal itself, while that of the former is composed of foreign material (grains of quartz &c.), with which the peculiar spiculiform bodies of the latter, too, are often mixed, I think there would be hardly any appreciable difference. It is much more abundant than *R. spiculotesta*, whose shell is somewhat larger, whiter towards the margin or in the uncoloured portion, and darker in the centre. The flattened rim, although extremely thin, still may be chambered.

It is remarkable that *R. concamerata* (Williamson, Recent

Foram. of Great Britain, 1857, p. 52, fig. 104, pl. iv.), which has a poriferous calcareous test, and, in its parasitic form, is very common on the root-portion of *Laminaria bulbosa* here (Budleigh-Salterton, Devon), is always surrounded by an accumulation of quartz-sand, apparently taken up by its sarcodic cuticle, which accumulation often extends so far up as to cover the summit, and thus conceal the original test, when it so far very much resembles *R. arenacea.* Indeed Williamson's *R. inflata* (*op. cit.* p. 50, figs. 93, 94, pl. iv.), which was found on *this* coast, has an arenaceous test; and it may be that this form, after all, is his *R. concamerata*, in which the arenaceous layer has been retained; while the calcareous one still presents the nautiloid spire of chambers *inside*, as in *R. arenacea.* Thus, as I have before stated ('Annals,' 1877), the arenaceous test may be as much perforated as the original calcareous one, whose pores or perforations may for some time be seen through it, although, from the heterogeneous character of the material in every respect, they cannot be so regular or so distinct. I have made a similar statement before regarding the perforated state of arenaceous tests termed by authors "imperforate" ('Annals,' 1877, vol. xix. pp. 204, 205, pl. xiii. figs. 7*f* and 23–29). In short, it seems to me to be an *axiom* that *every Foraminifer possessing a calcareous, may have an arenaceous representative test*, which also seems to hold good among the sponges, wherein the same form may at one time belong to the Psammonemata and at another to the Rhaphidonemata, &c.; that is, the fibre in the first instance may be axiated with foreign bodies, and in the second with bodies (spicules) formed by the sponge itself ('Annals,' 1875, vol. xvi. p. 126, Notes Introductory to a Study of the Spongida).

Here, too, I might allude to *Squamularia varians* ('Annals,' 1870, vol. v. p. 321, pl. v. fig. 1, &c.), which, having appeared to me to be the "arenaceous representative" of Max Schultze's genus, justified this name. All are aware that Max Schultze in his 'Organismus,' &c., and Dr. Carpenter, in his 'Introduction,' took the form to which Max Schultze gave the name "*Squamulina*" for the *basis* of their classifications, on account of its simplicity; but Max Schultze's specimen was smooth, imperforate, and calcareous, as the original diagnosis points out, viz.:—"Schale einer planconvexen, flachen Linse gleichend; mit der planen Seite festgeheftet, kalkig, eine einfache, ungetheilte Höhlung einschliessend. Eine grössere Oeffnung auf der convexen Seite; feine Poren fehlen" ('Organismus der Polythalamien,' Foraminiferen, 1854, p. 56, Tab. vi. figs. 16, 17). Hence objections have been made to my nomenclature; but if I am right in assuming the "axiom" just mentioned, then *S. varians* is as much a *Squamulina* as the smooth (*glatt*) calcareous test first observed by Max Schultze on the sides of "the glass" at Ancona. *Polymorpha silicea*, which Max Schultze also found at this place, and has figured next to his *Squamulina levis* (*op. cit.* Tab. vi. fig. 10), is an *arenaceous* form of D'Orbigny's calcareous Foraminifer, and therefore an instance in point.

Perhaps I may be also pardoned for again introducing *Squamulina scopula* (*Haliphysema Tumanowiczii*, Bk.), which most observers will not admit to be a species of *Squamulina*. Thus Möbius, in his late valuable work on Foraminifera of the Mauritius ('Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen, mit 14 Tafeln, 1880,' a copy of which he kindly sent me), observes at p. 75, "Da aber Bowerbank's *Haliphysema* mit Schwammnadeln und diesen ähnlichen Fremdkörpern besetzt war, so durfte sie dem Schultze'schen Gattungsbegriff *Squamulina* nicht untergeordnet werden, sondern sie musste als eine eigene Thiergattung erhalten bleiben." But in his arrangement *Squamulina scopula* (*Haliphysema Tumanowiczii*, Bk.) is placed at the commencement (that is, at the bottom of his Foraminifera), under the heading "Imperforata;" so that at least it would come *near* to *Squamulina*. Still, from what I have stated about the perforation of arenaceous tests being, *mutatis mutandis*, the same as that of the poriferous calcareous ones, and his figures of "*Haliphysema Tumanowiczii*" (Taf. i. fig. 4) actually representing an extension of the sarcode in pseudopodiform filaments from *all parts* of its arenaceous test, I am still more at a loss to conceive how this kind of test generally can be called "imperforate."

Admitting, then, for argument that *Squamulina scopula* should form a distinct genus under the term "*Haliphysema*," it may be asked, "upon what grounds is this done when its podal disk so closely represents *Squamulina varians* that this part must be considered the *test*, and the erect development a prolongation in this form of the oral aperture?" This may be answered by another question, viz. "Was *Carpenteria*, in 1858, so named from a similar prolongation of *its* oral aperture to that of *Squamulina scopula*, which was not discovered until 1877 ('Annals,' vol. xx. p. 68)?" Then it is the *test*, and *not* the *appendages*, which should afford the generic name; hence I cannot help thinking that *Squamulina varians* and *S. scopula*, which abound *here* together on the root of *Laminaria bulbosa*, are, with perhaps a very slight approach to a polythalamous interior of the podal part, which is the test in the latter, generically the same. Otherwise of what calcareous foraminiferal test is the arenaceous *Squamulina scopula* the representative?

SPONGIDA.

CARNOSA.

Halisarca rubitingens, n. sp. (provisional).

Amorphous, indefinitely spreading and agglomerating together every thing in its course, at the same time that the whole is tinged externally by its red colour, appearing in the form of a thin membrane when stretched across cavities, composed of polygonal divisions (cells) in juxtaposition, filled with granular contents in which the pigment is situated. Divisions varying in size under 5-6000ths inch in diameter.

Hab. Marine.

Loc. Gulf of Manaar.

Obs. At first *Halisarca rubitingens* appears like a *Hildenbrantia*; but the absence of distinct cellular structure, no conceptacles, and its greater thinness are opposed to this view; at the same time these characters do not satisfy me as to its being a species of *Halisarca*; hence I have named it "provisionally" (that is, until it has received examination in the living state).

PSAMMONEMATA.

Hircinia clathrata, n. sp.

Skeleton kerataceous, massive, sessile, lobate; lobate portions passing into thick digital processes, subbranched, hollow, clathrate. Texture stiff, resilient. Colour light brownish yellow. Surface irregularly clathrous, covered with minute points (conuli). Structure uniformly reticulate, chiefly composed of simple, solid, translucent, amber-coloured fibre, here and there charged with foreign bodies (quartz-grains and sponge-spicules), especially towards the surface, where the "points" are all areniferous; forming an irregularly fissured, clathrous, thin wall, varying under a quarter of an inch in thickness, which presents itself under the general form mentioned. Size varying from 6 to 12 inches in height and breadth.

Hab. Marine.

Loc. Gulf of Manaar; Red Sea.

Obs. I have never seen to my knowledge any thing but specimens of the skeleton of this sponge, which, being very tough and durable, have in all probability been picked off the beach; at the same time, if they had been taken alive and preserved in spirit with the sarcode present, they would have so much resembled other species of *Hircinia* of a like kind that, after all, we should have to fall back upon the skeleton for specific differences. Here, however, the clathrous character and *hollow* condition of the mass (for its general form is only represented by a comparatively thin wall of sponge) are so striking, together with its great abundance and luxuriant growth, if one may judge by the specimens, that it can hardly fail to be recognized.

There is a similar sponge at the Mauritius; but although it presents the same clathrous character, it is massive and *solid* throughout, with a dark purple-red sarcode; so there is no confounding the two. But the sarcode of *H. clathrata* may have been so coloured, or it might have had a dark dermal sarcode; for both the *outer* part of the Mauritius specimen and *H. clathrata* generally are, by "washing out," of the *same* colour. So far, then, it is desirable to see these sponges alive, when, of course, the sarcode is present. Such remarks apply to specimens of the Hircinida generally. My Mauritius specimen came to me through Dr. Dickie in 1872, to whom Col. Pike, U.S. Consul there, had sent it; but in all probability the hollow species, viz. *H. clathrata*, is also to be found in the sea about that island.

RHAPHIDONEMATA.

Family 2. **Cavochalinida.**

Group 5. TUBULODIGITATA.

Tubulodigitus communis, n. sp.

Rhizomatous at the base, consisting of a mass of short, bullate, subbranched, more or less laterally united, erect digital processes, rising from an irregular spreading growth of a similar kind. Stiff, resilient. Colour purple, becoming light brown when washed out. Processes tubular; vents single, terminal. Spicule of one form only, viz. acerate, fusiform, gradually sharp-pointed, smooth; smaller in the axis than at the circumference of the fibre. Size of specimen about 9 inches in diameter each way, by 3 inches high.

Hab. Marine.

Loc. Gulf of Manaar.

Obs. In my "Notes Introductory to a Study of the Spongida" ('Annals,' 1875, vol. xvi. p. 141) this kind of Chalina has been described; but although the character of the "Family" is recorded, I had not time then to give an illustration of the "Group" at p. 194 (*ibid.*), which is herewith done and named for this purpose. I expect that the species is common; but it differs from the group "Digitata," which is even perhaps still more common, in the processes being hollow or tubular instead of solid; that is, the vents of the excretory system open interiorly into the general tube ("cloaca," Bk.), terminating at the extremity in the former, instead of here and there, laterally, along the outside of the cylindrical process in "Digitata."

ECHINONEMATA.

Halichondria plumosa, Johnston.

A small patch of the microcioniform variety (see Bowerbank's 'British Spongiadæ,' 1874, vol. iii. pl. xxiv. figs. 7–13), about three quarters of an inch in diameter.

Loc. Gulf of Manaar.

Obs. In company with *Microciona affinis* and *Hymerhaphia unispiculum*, each about the same size, also *Leucortis indica*, Häckel, a calcareous sponge, and *Polytrema cylindrica*, growing together on a Melobesian nodule about 1½ inch in diameter.

Hymerhaphia eruca.

Of this sponge only one small specimen was found among the first set of Melobesian nodules that I examined; but in these, the second set, it has been found in three or more places in abundance; so the existence of this remarkable species is thus established.

Loc. Basse Rocks.

HOLORHAPHIDOTA.

Amorphina megalorhaphis, n. sp.

Massive, irregularly lobed, tender, white. Surface irregular. Structure amorphous, confused; traversed by branches of the excretory canal systems, which are large and terminate respectively in scattered vents. Spicule of one kind only, viz. acerate, curved, fusiform, gradually sharp-pointed, smooth; varying in length from 1-128th to 1-23rd inch. Size of specimens about 1½ inch in diameter each way.

Hab. Marine. Growing over *Balani* and sea-bottom.

Loc. Basse Rocks.

Obs. This seems to be a variety of the common British species *Halichondria panicea*, chiefly differentiated by the size of its largest spicules, which is double that of the English one. The spicules also of the specimens brought home by the Rev. A. E. Eaton from Kerguelen's Island, and others dredged up by H.M.S. 'Porcupine' in the Atlantic Ocean, are much larger than those of the common British species; so that this variation may extend even to our own shores, while the single form, great variety in size, and long attenuation towards the end of the spicule generally characterize the species everywhere.

Halichondria infrequens, n. sp.
(Pl. XVIII. fig. 9, *a–d.*)

Of this sponge I can only record its spiculation, which was found to the extent of half an inch on the surface of *Discodermia sinuosa* (to be hereafter mentioned). Spicules of four forms, viz.:—1, skeleton, acerate, curved, fusiform, obtusely pointed at the ends, thickly microspined throughout (fig. 9, *a*); 2, subskeleton (tibiella), cylindrical, straight or undulatory, inflated at each end, smooth (fig. 9, *b*); 3, flesh-spicule, bihamate, simple, contort, large (fig. 9, *c*); 4, flesh-spicule, equianchorate, rather inclined to the "angulated" (Bowerbank) kind (fig. 9, *d*). No. 1 forms the body structure; and 2 is chiefly confined to the surface, where the flesh-spicules are also most numerous.

Hab. Marine.

Loc. Gulf of Manaar.

Obs. The chief character here is the thickly microspined acerate skeleton-spicule, which may perhaps be the representative of the spined acerate in *Halichondria incrustans.*

The Tibiella. (Pl. XVIII. fig. 9, *b*.)

From time to time, as it becomes evident that a certain form of spicule is common to many sponges under various modifications, it is desirable that a generic name should be given to it, to avoid periphrasis in description; and thus I propose "tibiella" for that spicule so common among the Fibulifera, Halichondrina, and some of the Suberitida, which has a distant resemblance to the shin-bone, in which the shaft may be straight or crooked, cylindrical or fusiform, long or short, thick or thin, with the extremities simply pointed or obtuse, or inflated and hastate, or inflated and clavate, spined all over or only at the extreme end. Such are some of the modifications which may be presented by Dr. Bowerbank's "biclavated cylindrical" spicules ('British Spongiadæ,' vol. i., Terminology, p. 231, pl. i. fig. 19), and by "no. 2" in the above description of *Halichondria infrequens* (Pl. XVIII. fig. 9, *b*).

Cliona Warreni, n. sp.

(Pl. XVIII. fig. 6, *a–d*.)

Burrowing under a layer of *Melobesia*, and coming to the surface through circular apertures scattered irregularly over the Melobesian nodule (fig. 6, *a*). Colour dark brown now. Apertures 1-16th to 1-8th inch in diameter; the smaller ones poriferous and filled with a tuft of pin-like spicules held together by dark brown sarcode, with their points outwards (fig. 6, *b*); the larger ones, being vents, are empty and open (fig. 6, *c*). Spicule of one form only, viz. pin-like; head almost spherical, neck much constricted; shaft large, fusiform, thicker than the head, curved, gradually sharp-pointed, the whole smooth (fig. 6, *d*), total length 1-51st inch. Size of nodule about 1½ inch in diameter.

Hab. Marine. Burrowing under *Melobesia.*

Loc. Gulf of Manaar.

Obs. The form of the spicule generally and there being no others, together with the dark brown sarcode (when dry), contrasting strongly with the light-coloured *Melobesia* through the circular openings, characterizes this species. As regards the present colour, it does not differ much from that of *Cliona celata* when dry, which in its fresh state may be golden or chrome-yellow.

Suberites fistulatus.

In the description of this sponge (in the former report) I have omitted to mention the presence of a minute, simple, tricurvate flesh-spicule, about 5-6000ths inch long—that is, about half the length of the equianchorate, which anchorate, again, in its full development, is so much bent as to cause the middle arms to be closely approximated.

Thoosa socialis.

Having found a good specimen of this species lining the sponge-eaten cavities of a Melobesian nodule, and stretching across them in thin films, a bit of the latter was placed in water under the microscope for examination, when the peculiar spicule characterizing this species ('Annals,' 1880, vol. vi. pl. v. fig. 23, *a*) was found to be accompanied by the same kind of flesh-spicules as those of *Alectona Higgini* (*ibid.* fig. 25, *b*, *c*), while the cake-shaped form (fig. 23, *b*, *c*) was not present.

This at first appeared to me inexplicable; but on comparing the characteristic skeleton-spicule of *Thoosa socialis* (*l. c.*) with that of *Alectona Higgini* (fig. 25, *a*) it became evident that the two are very nearly allied in form; and as no flesh-spicules were formerly found with *Thoosa socialis*, it is not improbable that one is but a variety of the other. * The sceptrellum, however, although alike in form, is more than twice the size of that in *Alectona Higgini*, while the linear spicule is not so long. The "bit of film" examined having had no direct connexion with the rest of the sponge lining the cavity, is proof that these sponge-spicules formed *part* of the spiculation of *Thoosa socialis*, and were not accidental occurrences.

Stelletta crassicula, n. sp.

Globular, firm. Colour brown-grey. Surface even, areolar, formed by the spreading heads of the bundles of zone-spicules, through which those of the anchoring-spicules project, tympanized in the intervals by the dermal sarcode. Pores in the dermal sarcode. Vents single, scattered here and there. Internal structure, as usual, hard and tough; the bundles of zone- and body-spicules extending nearly to the centre, as they are large and the specimen very small. Spicules of six forms, viz. four skeleton- and two flesh-spicules. Skeleton-spicules:—1, zone-spicule trifid, arms spreading laterally, slightly extending forwards, and recurved, shaft long and smooth, gradually sharp-pointed, head 1-360th inch in diameter, shaft 1-9th inch long; 2, body-spicule large, acerate, curved, fusiform, gradually sharp-pointed, smooth, 1-9th inch long; 3 and 4, anchor and fork, head of largest anchor about 1-150th inch in diameter, shaft variable, 1-9th inch long or more. Flesh-spicules:—5, minute acerate, thin, curved, fusiform, gradually sharp-pointed, smooth, about 1-80th inch long; 6, stellate, as usual minute, delicate, with a variable number of straight arms radiating directly from the centre without nucleus, about 1-3000th inch in diameter. Nos. 1–4 are in bundles, the anchors and forks projecting a little beyond the surface, and the flesh-spicules chiefly confined to the dermal sarcode. Size $\frac{1}{8}$ inch in diameter.

Hab. Marine. On a Melobesian nodule, attached by the anchoring-spicules.

Loc. Basse Rocks.

Obs. The smallness of this specimen compared with the large size of its skeleton and anchoring-spiculation, especially the projecting heads of the anchors, at once characterizes it; but when the dermal acerate flesh-spicule is added, the distinction of the species becomes complete so far, since I do not know another instance in which the dermal flesh-spicule is at the same time smooth and so large.

Discodermia sinuosa, n. sp.
(Pl. XVIII. fig. 1, *a–h*.)

Surface even, discophorous; disks (fig. 1, *a*) at first simple, in juxtaposition, peltate, then foliate, with shallow denticulate margin (fig. 1, *b*); afterwards more deeply notched and foreshadowing a trifid division, with a tendency in some of the notches to assume a circular form (fig. 1, *c*); then the same more intensified and larger, when, overlapping each other *in situ*, the circular notches become converted into apertures, and then more especially present the sinuous lines which characterize the species (fig. 1, *d*); finally transmuted into branches which, becoming subdivided towards the extremities, end in filigree expansions (fig. 1, *e*), which, in the deeper and fully-developed structure, interlock with their neighbours by subround tubercles constricted at the neck, which thus form a grape-like mass (fig. 1, *f*). Disk at the commencement or when first recognizable simple, subcircular, with even margin and short, central, smooth-pointed shaft projecting inwards, nail-like, from the lower surface, and encircled above by faint, broken, concentric *lines*, about 1-300th inch in diameter (fig. 1, *a*). Flesh-spicule minute, fusiform, somewhat inflated in the centre, microspined and slightly curved (fig. 1, *g*, *h*), abundant throughout, but especially over the discophorous or external layers. Size of largest specimen, which is considerably worn and has been deprived of its disks, about half an inch in diameter each way; that of the smallest, which is thin and spreading, hardly more than the discophorous or outer layers thick.

Hab. Marine. On Melobesian nodules.

Loc. Gulf of Manaar; Basse Rocks.

Obs. The circular notches of the disks separately, and the sinuous lines which they present when overlapping each other *in situ*, are almost identical with what is seen in *Kaliapsis cidaris*; but the absence of papillary projections on the surface in the former at once points out the difference.

Discodermia sceptrellifera, n. sp.
(Pl. XVIII. fig. 2, *a–h*.)

Surface even, discophorous. Colour yellow, becoming reddish brown under the influence of nitric acid. Disk simple, circular, with even margin, presenting faint, irregular, concentric lines; provided with a short, sharp-pointed, smooth shaft, projecting inwards, nail-like, from its under surface (fig. 2, *a*); soon becoming irregular in its outline (fig. 2, *b*), which assumes a trifid division (fig. 2, *c*), still more developed in fig. 2, *d*; ultimately passing into a four-armed, lithistid spicule, whose branches, becoming subdivided towards the extremities, end in filigree expansions (fig. 2, *e*), which, in the deeper and fully developed structure, interlock with their neighbours by a few straggling subround tubercles (fig. 2, *f*). Flesh-spicule short, thick, sceptrelliform, coarsely spined round the centre and at each of the ends (fig. 2, *g*, *h*); extremely abundant throughout, but especially on the surface. Size of specimen about ¼ inch in all ways.

Hab. Marine. On a Melobesian nodule.

Loc. Gulf of Manaar.

Obs. The specimen of this species had become overgrown with a layer of *Melobesia*, and would have remained thus concealed but for an accidental fracture, which, passing through, caused it to separate into two portions, one of which, having been boiled in nitric acid, revealed the character of its spiculation all but the circular form of the disk (fig. 2, *a*), whose existence, in description and delineation, is thus inferred. The specimen is not only small but imperfectly developed; so that I am not quite certain that fig. 2, *f*, represents the ultimate development of the filigree—that is, as it would be in the deeper structure.

On the same small nulliporiform nodule, which is not more than an inch in diameter, there is a portion of *Discodermia aspera*, which presents a similar yellow colour, one of *Corallistes verrucosa* overgrown by *Hymerhaphia eruca*, *Carpenteria utricularis*, *Rotalia spiculotesta*, *Polytrema miniaceum*, &c., showing how many different organisms may exist on one small Melobesian nodule.

Specimens from Bass's Straits, South Australia.

CARNOSA.

Halisarca bassangustiarum, n. sp. (provisional).

Among the "dredgings" from Bass's Straits are two more or less thin, light, corrugated, even-margined, subcircular specimens about an inch in diameter each, one of which is dark purple, almost black, and the other brown in colour. Both are charged with globular bodies like cells, about 3½ 6000ths inch in diameter; but while these are indistinct in one of them, they are well-defined, spheroidal, and capsular in the other. How far these specimens may have been brought to this state by exposure in the waves and on a hot dry beach I cannot say; but to expect *Halisarca* after such exposure to present any of its original features is out of the question. All, therefore, that I can add is that the "brown" specimen in a smaller state appears again attached to *Dictyocylindrus reticulata* (to be described hereafter) from the same locality, and charged with the same kind of spherical capsular bodies (? ova), where it so far manifests all the appearance of *Halisarca*, that I can hardly doubt that both are dried specimens of one and the same, for which I propose the name above given. Neither becomes gelatinous when soaked in water, although when dry the brown specimen presents here and there the appearance of dried glue, which the dark specimen does not. I admit that this description is not satisfactory; but under the circumstances it cannot be otherwise; at the same time it is desirable that it should be recorded, to induce future observation.

Loc. Bass's Straits.

PSAMMONEMATA.

Dysidea Kirkii, Bk., 1841.

Massive, sessile, more or less contracted at the base, thick, erect, more or less compressed, simple, lobate; lobes passing into mamilliform, digital, or subbranched processes; sometimes digitate and branched, *Chalina*-like. Texture subfragile. Colour, when fresh, purplish or grey. Surface even, fibroreticulate, with the interstices tympanized by the dermal sarcode. Vents terminal, large, situated at the *ends* of the lobate, mamilliform, or digital processes, which are often in a line on a serrated crest or ridge. Pores in the dermal sarcode. Internal structure fibro-reticulate, traversed by channels of the excretory canal-systems, which terminate in the vents just mentioned; fibre composed of foreign bodies (quartz-grains, sponge-spicules entire and fragmentary, &c.) held together by a minimum of sarcode in the form of crooked anastomosing threads, whose interstices being also tympanized by sarcode, produce a uniformly areolated tissue, which may be slightly interrupted by a little development in excess of the vertical over the transverse fibre. Size variable; the largest specimen I have seen was about 5 inches long, 4 inches high, and 1½ inch thick.

Hab. Marine. Growing on hard objects, which, if hollow, frequently have their interior filled with it.

Loc. The whole coast of South Australia; Mauritius and Cape of Good Hope.

Obs. In the year 1840 "Rupert Kirk, Esq.," of Sydney, Australia, sent to Dr. Bowerbank "about fifty species of various genera of sponges" (Trans. Micr. Soc. London, 1841, vol. i.

p. 32); and among them Dr. Bowerbank noticed one almost identical with *Dysidea fragilis*, Johnston, to which he gave the name of "*Dysidea Kirkii*" (*ibid.* p. 63, pl. vi.). This species in structural composition appeared to Dr. Bowerbank to be, if any thing, still more arenated than *D. fragilis*; thus he states, "in *D. fragilis*, Johnston, the primary fibres are often as abundantly arenated as those of the Australian species, while the secondary ones are only partially filled with extraneous matter; and in this condition they are more or less tubular" (Brit. Spongiadæ, 1864, vol. i. p. 212). After this, viz. in 1874, Dr. Bowerbank gave some very good representations of *Dysidea fragilis* from specimens now in the British Museum, which I have examined, but, *as they appear when dry and washed out upon our beach* (*op. cit.* vol. iii. pl. lxix.).

Now Col. Montagu, in 1812, who appears to have first noticed this sponge on the "south coast of Devon," called it *Spongia friabilis* (Wernerian Mem. 1818, vol. ii. p. 114, pl. xvi. figs. 1, 2), which Johnston, who states that Montagu's account was "read to the Society on the 9th March, 1812" (Hist. Brit. Sponges, 1842, p. 37, footnote), changed generically to "*Dysidea*;" so that, besides having examined Dr. Bowerbank's type specimens now in the British Museum, I am living on the coast where Montagu found the original specimens; and, so far as the dead and "dried form washed out on the beach" goes, the descriptions and delineations respectively are accurate; but *not so* as regards the appearance of this sponge while growing *in situ* on the rocks; for there it is almost identical with the representation of *Spongelia incrustans* given by Schmidt (Spong. Adriat. Meeres, Taf. iii. fig. 7). Schmidt himself has identified *Dysidea fragilis* with *Spongelia*, Nardo (*op. cit.* 1866, 2nd Suppl. p. 11), but *provisionally*, because he had only seen one of the "dried" and washed-out specimens to which I have alluded. It seems to me therefore that Montagu's *Spongia friabilis* of 1812 is Johnston's *Dysidea fragilis* of 1842 and Nardo's *Spongelia* of 1847, of which the best representation in the free state that I have seen has been given by Prof. F. E. Schulze of *Spongelia pallescens* (Zeitschrift f. wiss. Zoologie, Bd. xxxii. Taf. v. fig. 2), the slight variation in appearance between *Spongelia pallescens* and *S. incrustans* here being of no consequence.

To return to *Dysidea Kirkii*, Bk., I cannot see much difference in structure between it and *Dysidea fragilis*, both with and without the sarcode; but in general form, colour, and perhaps in the form of the points (*conuli*) on the surface being less prominent, it differs, as will have been seen by the above description.

There is, however, a large specimen (? 3 inches in its longest diameter) in the Bowerbank collection now in the British Museum labelled "coast of Suffolk, Dr. W. B. Clarke," in which these conuli are turned into little round balls that, touching each other, give the whole surface a granulated appearance; in short they are the *conuli* thus inflated, which, again, are the circumferential terminations of the vertical fibre, that in this species or variety (for which I would suggest the name of *Dysidea granulata*) are more than ordinarily enlarged.

In my classification, this genus forms the type of the group "Arenosa," which is the last of the family "Hircinida" in my order "Psammonemata," and represents the opposite state to that of the group "Euspongiosa," viz. the first of this order, with respect to the amount of foreign material which its fibre contains, inasmuch as, while there is hardly a trace in the Euspongiosa (ex. gr. *Spongia officinalis*), there is so much in *Dysidea* that it is barely removed from sand itself. Thus *Dysidea* bears to *Spongia officinalis* the same kind of relation that some of the order Holorhaphidota, whose fibre is almost entirely composed of spicules, bear to the kerataceous fibre of some of the Rhaphidonemata, in which the spicules are frequently very scanty.

As regards geographical distribution, the very fact of the genus *Dysidea* being the first step towards the development of the Psammonemata, which may be said to culminate in *Spongia officinalis*, where the kerataceous element is almost every thing, and the arenaceous one or that of foreign bodies almost *nil*, it might be fairly assumed that, if any part of the order more than another is prevalent over the world, it will be *Dysidea* = *Spongelia*, Nardo; at least, this is the case in the British Isles, as may be seen by reference to Dr. Bowerbank's 'British Spongiadæ' (vol. iii. 1874), where, with the exception of a few insignificant specimens of his *Spongionella pulchella* (pl. lxv. figs. 5–8) and *Verongia zetlandica* (pl. lxx. figs. 9–11), nothing but the representations of *Dysidea fragilis* is given. Yet the whole order appears to exist in the greatest luxuriance on the south coast of Australia, especially about the south-west angle, judging from the specimens (skeletons for the most part) which have been picked up and sent to England alone, of which the collections in the British Museum (that is, including those which belonged to the late Dr. Bowerbank) represent perhaps the finest and most varied specimens of the greatest number of species brought together in Europe. Among these are a vast number of specimens of *Dysidea Kirkii* in all states, from crumbling fragility, owing to the absence of sarcode destroyed chiefly by the presence of sea-salt, to comparative firmness, with the dried sarcode still left about them; and it is from this numerous collection, together with several belonging to the Liverpool Free Museum, which were dredged off Curtis Island, in Bass's Straits, by Capt. H. Cawne Warren, that the description above given has been taken. Among the latter is one on the branches of a specimen of *Mopsea* (*Isis*) *encrinula*, Milne-Edw., to which I might add another from Algoa Bay on a specimen of *Mopsea gracilis*, Milne-Edw., sent me by my friend Dr. Dickie in 1873.

The kind of arenaceous foreign material in *Dysidea Kirkii* will of course depend upon that of the locality: viz. if only arenaceous, it will be chiefly composed of sand-grains; if spiculiferous, of sponge-spicules and their fragments, &c. But there is one element, viz. a little prism of calcite, generally banded with brown, yellow, or red, singly or in conjunction, that might puzzle the observer if it were not stated that this comes from the disintegrated structure of very thin bivalve shells like *Pinna*; hence the prismatic form and banded colours.

The ubiquitous parasite *Spongiophaga communis* also occasionally infests *Dysidea Kirkii.* Again *Oscillaria spongeliæ*, Schulze, appears apparently as a commensal in *Spongelia pallescens*, wherein Prof. Schulze has found it *even* in the embryo, as his published accounts will show (Zeitschrift f. wiss. Zoologie, Bd. xxxii. Taf. v. fig. 7, &c.), and also preparations which he kindly sent me. Marshall, too, represents an Oscillatorian in the "syncytium" of his *Psammoclema ramosum*=*Dysidea ramosa*, Häckel in sched. (*ib.* Bd. xxxv. p. 111, Taf. vii. fig. 15). *Spongiophaga communis*, however, is a destroyer, and not a commensal. At what period these parasites enter the sponge may be a matter for speculation, but can hardly be one of certainty, as in Schulze's case they were found *in the embryo.*

All the specimens of *Dysidea Kirkii* that I have seen have been *dry*; but as *Dysidea* is one and the same with *Spongelia*, which Prof. Schulze has studied in the Adriatic while *fresh*, I cannot do better than refer the student to his paper for all this part of the subject (Zeitschrift f. wiss. Zoologie, Bd. xxxii. p. 117 &c. Taf. v.–vii. 1878).

ECHINONEMATA.

Dictyocylindrus reticulatus, n. sp.

(Pl. XVIII. fig. 7, *a*–*c*.)

Feathery, branched, tufted, stiff. Colour brown. Surface rough, composed of lacinulated tufts projecting through the reticulate structure, which tufts are the ends of the ultimate branches flattened and divided into penicilliform processes; reticulated structure consisting of sarcode echinated with small spined spicules. Neither the pores nor the vents seen, from the contracted state of the tissues; but probably the former in sarcode tympanizing the interstices of the dermal reticulation, and the latter numerous and small, as is usual in the Echinonemata. Spicules of two kinds, viz.:—1, skeleton-, acuate, curved, slightly inflated at the large end, gradually sharp-pointed, smooth, about 1-40th by 1-1500th inch in its greatest dimensions (fig. 7, *a*); 2, flesh- or echinating spicule, clavate, without enlarged head, sharp-pointed, spined throughout, spines recurved from the point backwards, about 1-240th by 1-2000th inch in its greatest dimensions (fig. 7, *b c*). The skeleton-spicules form the axial structure, appearing setaceously at the ends of the penicilliform processes; while the flesh-spicules echinate the meshes of the reticular sarcode most profusely. Size of branches, of which there are two that appear to have grown with others from the same point on some hard object, 2½ inches high by 1½ inch broad in the expanded head.

Hab. Marine.

Loc. Bass's Straits.

Obs. The characteristic feature of this species is its dermal reticulation, in which the meshes are densely charged with the echinating spicules, thus presenting a beautiful and equally characteristic feature of the Ectyonida or first family of the order. The spiculation is like that of *Dictyocylindrus* in general, but not the same in particular, while the general form is different from that of all hitherto described species.

It is on a part of this specimen that the specimen of *Halisarca bassangustiarum* to which I have alluded is attached.

While the rough lacinulated surface above noticed is common to many of the Echinonemata, there are others which are as equally and uniformly smooth, like that of the following species:—

Echinonema typicum, n. sp.

Shrubby, cauliculate, more or less compressed bunch-like or clustral, consisting of a great number of digital, more or less branched stalks spreading upwards from a contracted sessile base; more or less covered throughout by a whitish incrustation; branches cylindrical, round, or slightly compressed, more or less subdivided, terminating in obtuse round ends. Consistence firm, resilient. Colour white, or brown when the incrustation has been rubbed off. Surface even, covered with the white incrustation mentioned, in which the vents appear like small pin-holes scattered numerously over the whole specimen, connected superficially with branched stelliform grooves, which are the collapsed channels of the excretory canal-systems to which they respectively belong. Pores not seen, but, in all probability, in the dermal sarcode supporting the incrustation. Internal structure tough, fibrous, kerataceous. Spicules of two kinds, viz.:—1, skeleton-, acuate, smooth; 2, flesh- or echinating spicule, clavate, spined; the former chiefly confined to the centre of the kerataceous fibre, and the latter echinating its surface, while both combined make up the white incrustation with which the surface is covered. Size variable, under perhaps 18 inches in diameter.

Hab. Marine.

Loc. South and S.W. coast of Australia.

Obs. This is perhaps the most abundant species on the south coast of Australia; and my description has been taken from at least a bushel of specimens, but all dry, and therefore only preliminary to that which may one day be made of this species when in the fresh state or well preserved in absolute alcohol, and studied after the satisfactory manner followed by Prof. F. E. Schulze of Gratz. (See "Structure and Arrangement of the Soft Parts in *Euplectella aspergillum*," Voyage of H.M.S. 'Challenger,' 1880.)

Echinonema anchoratum, n. sp.

Flat, fan-shaped, thin, more or less stipitate. Like the last species in every thing but form and spiculation, the latter only differing in the presence of a small naviculiform equianchorate flesh-spicule. Size variable, under 8 inches in diameter.

Hab. Marine. Common.

Loc. South coast of Australia.

Obs. The presence of the equianchorate, together with the general form, distinguishes this from the last species; yet I have seen some specimens with round cylindrical stalks, like those of *E. typicum*, also charged with this little navicular form of equianchorate, which is the same as that of the Microcionina; so its presence or absence, probably, in the Ectyonida does not go for much in specific determination.

I have given descriptions of these two species, not only because the former is among the specimens dredged by Capt. Warren, but because I have alluded to this *type* by name only in my "Notes Introductory to a Study of the Spongida" ('Annals,' 1875, vol. xvi. p. 195), as promised in the "third part" of this publication, for the illustration of one of the genera, to be hereafter included in the provisional group "Pluriformia."

Acanthella stipitata, n. sp.
(Pl. XVIII. fig. 8.)

Head globular, branched, aculeate, supported on a long naked stem. Stiff. Colour now brownish green. Surface composed of aculeations which are the ultimate divisions of the branches, united together by fenestral expansions of sarcode. Spicule of one form only, viz. acuate, slightly curved or undulating, abruptly sharp-pointed, smooth, 25 by ⅔-1800th inch in its greatest dimensions (fig. 8); arranged in bundles in the branched head so as to project a little beyond the sarcode; confusedly in the stem, which is hard and compact. Size:—head 2 inches in diameter; stem, up to where it commences to branch into the head, 2 inches long by 1-6th inch thick, much worn and pointed towards the end, which has been broken off from its original point of attachment.

Hab. Marine.

Loc. Bass's Straits.

Obs. This sponge differs very little from Schmidt's *Acanthella acuta* (Spong. Adriat. Meeres, p. 75, Taf. vi. fig. 7), except in the size of the spicule, which is about five times smaller than that of the type specimen in the British Museum.

HOLORHAPHIDOTA.

Latrunculia purpurea, n. sp.
(Pl. XVIII. fig. 5, *a–c*.)

Flat, compressed, circular, thin, cake-like or fungiform, attached on one side by a constricted portion to a *mussel*-shell; texture compact, but not gelatinous. Hard. Colour dark brown-purple. Surface on the upperside, with which the peduncular portion is connected, ragged, proliferous, much darker than the (?) underside, which is even; margin thick, round, smooth, like the dark part generally. Internal structure compact, densely spiculous. Spicules of two kinds, viz.:—1, skeleton-, acerate, curved, subcylindrical, gradually sharp-pointed, smooth, 1-75th by 1-4000th inch in its greatest diameters (fig. 5, *a*); 2, flesh-spicule, sceptrelliform, consisting of a straight shaft spined over each end entirely and discoidly, and in two separate rings around the shaft on one side the middle line, the latter often commingled by an irregular disposition of the spines, about 1-857th inch long (fig. 5, *b*, *c*).

Skeleton-spicules chiefly confined to the body; flesh-spicules to the circumference, on the (?) upperside and darker portions, arranged perpendicularly in juxtaposition, with the spinous disk of one end outwards. Size of largest specimen (for there are two) about 1½ inch in horizontal diameter and 1-8th inch thick.

Hab. Marine.

Loc. Bass's Straits.

Obs. I have already described and illustrated a species of this kind from the Red Sea ('Annals,' 1879, vol. iii. p. 298, pl. xxvii. figs. 1–4), but with a differently formed sceptrellum and of a light colour; the form of the skeleton-spicule, however, is nearly the same—that is, acerate, not acuate like that of another much larger and light-coloured undescribed species from the south-western coast of Australia, viz. "Freemantle," that of the species dredged up by H.M.S. 'Porcupine' in the Atlantic Ocean, and that first named and described by Bocage, viz. *Latrunculia cratera* from St. Iago, in all of which the sceptrellum is differently formed.

In consistence *Latrunculia purpurea* is very much like *Halichondria suberea*, Johnston, = *Suberites domuncula*, Sdt., and in the manner of growth upon the mussel-shell very much like *Halichondria ficus*, Johnston.

AXONA.

In 1867 Dr. Gray gave the name of *Axos Cliftoni* to an unknown sponge whose spicule *only* had been figured by Dr. Bowerbank in 1864; and in 1873 Dr. Bowerbank described the sponge itself under the name of *Dictyocylindrus dentatus*, without any allusion whatever to Dr. Gray (for reference *in extenso* see 'Annals,' 1879, vol. iii. pp. 284–285, where the subject is fully considered and therefore need not be repeated in detail here). Taking Dr. Gray's name "*Axos*" for the genus, I have added two new species (*op. et loc. cit.*), and now find among Capt. Warren's dredgings from Bass's Straits (for all the species so far come from the south coast of Australia) two more, which, however, differ so much from the original one, viz. *Axos Cliftoni*=*Dictyocylindrus dentatus*, Bk., that, if they are found to be still further multiplied, it may be necessary hereafter to divide them into genera; wherefore it seems desirable at once to make a group of them under the name "Axona," with the following characters:—

AXONA, n. group.

Form variable, surface aculeated; aculeations consisting of

a condensation of the skeleton-spicules extended from a general axis similarly composed, or from the reticulated fibre of a general areolation. Spicules of two kinds, viz. skeleton- and flesh-spicules.

Axos anchorata, n. sp.
(Pl. XVIII. fig. 3, *a–f*.)

Cauliform, cylindrical, cactus-like, long, straggling, sessile, growing from a small root-like expansion on a *mussel*-shell (fig. 3); sometimes branched?; bent and twisted upon itself, snake-like *in the specimens*, apparently by accident, united where in contact. Caulis small at the commencement, slightly increasing afterwards and ? diminishing towards the extremity. Texture firm, but not hard. Colour now brown. Surface aculeated throughout with short, conical, or obtuse or terminally inflated processes, supported on reticulate ridges tending to a longitudinal arrangement; processes projected from the points of the intersection of the ridges (fig. 3, *a*). Vents numerous, scattered (fig. 3, *c*). Structure interiorly areolar throughout, not axiated; cells of the areolation formed by the sarcode tympanizing the interstices of the reticulated fibre (fig. 3, *b*). Spicules of two kinds, viz.:—1, skeleton-, acerate, nearly straight, fusiform, gradually sharp-pointed, smooth, 1-85th by 1-2000th inch in its greatest dimensions (fig. 3, *d*); 2, flesh-spicule, very minute, equianchorate, shaft round, much curved, arms *falcate-linear*, much spread, the central one almost in continuation with the curve of the shaft, and the other two at nearly right angles to it, about 1-1500th inch long (fig. 3, *e*, *f*). Skeleton-spicules arranged longitudinally in the reticulated fibre and aculeations; flesh-spicules scattered throughout the sarcode generally. Length of caulis in the specimen indeterminable; diameter near the base about 1-6th inch, further up 1-3rd inch.

Hab. Marine.

Loc. Bass's Straits, South Australia.

Obs. The cactus-like character of this stem at once points out its affinity with the genus *Axos*, although the original species, viz. *Axos Cliftoni*, is axiated by a condensation of the skeleton-spicule, like that of *Cladorhiza abyssicola*, Sars, and *Chondrocladia virgata*, Sir Wy. Thomson, from the Atlantic Ocean, whose position also among the Holorhaphidota is not yet determined. In general form, when fresh, *Axos anchorata* seems to have been something like that species of *Cactus* commonly called "creeping cereus" (*C. flagelliformis*); and so far again it resembles the long stems of *Axos Cliftoni* (see Dr. Bowerbank's excellent figure, Proc. Zool. Soc. Lond.

1873, pl. xxix.), which, however, branch off in great plurality from a short thick stipes and are not single and sessile as in *Axos anchorata*; but the specimens from which I have been obliged to take my description are so imperfect that, although there is sufficient to establish the species, especially in the peculiar form of the equianchorate, further observation is necessary for its completion; and such is the case with the following fragment, which amounts to nothing more than 3 inches of the stem, with neither root nor termination, but yet again presents sufficient for specific determination, and may be described under the proposed designation of "*fibulata*" as follows:—

Axos fibulata, n. sp.
(Pl. XVIII. fig. 4, *a–c*.)

In general form and structure this species appears to have been the same as the foregoing, differing only in its spiculation, which consists of two kinds of spicules, viz.:—1, skeleton-, acerate, curved, fusiform, gradually sharp-pointed, smooth, 1-111th by 1-2400th inch in its greatest dimensions (fig. 4, *a*); 2, flesh-spicule, very minute, simple, bihamate (*fibula*), 1-2400th inch long (fig. 4, *b*, *c*). Spicules arranged as in the foregoing species. Size of specimen, including the bends of its contorted condition, about 4 inches long by ¼ inch in diameter.

Hab. Marine.

Loc. Bass's Straits, South Australia.

Obs. This, as before stated, is a very poor specimen and requires even still more observation to complete its description than that of *A. anchorata*, especially as the bihamate is simple and therefore does not afford the peculiar character of the equianchorate in *A. anchorata*.

Following is the supplementary list of Foraminifera and Spongida obtained from dredgings in the Gulf of Manaar and the sea in the vicinity of the Basse Rocks, together with one of the Spongida dredged in Bass's Straits, South Australia.

Specimens from the Gulf of Manaar and the Basse Rocks indicated by the abbreviations G. M. *and* B. R. *respectively.*

FORAMINIFERA.

Polytrema miniaceum. G. M.
—— cylindricum. G. M.
Carpenteria utricularia. G. M.
Gypsina melobesioides. G. M.
Rotalia spiculotesta. G. M. and B. R.
—— arenacea, n. sp. G. M. and B. R.
Holocladina pustulifera. G. M.

SPONGIDA.

Ord. i. CARNOSA.

Halisarca rubitingens, n. sp. prov. G. M. and B. R.
Chondrilla nucula. G. M.

Ord. iii. PSAMMONEMATA.

Hircinia fusca. G. M. and B. R.
Hircinia clathrata, n. sp. G. M.

Ord. iv. RHAPHIDONEMATA.

Tubulodigitus communis. G. M.
Oceanapia (Desmacidon, *Bk.*) Jeffreysii. Australian variety, viz. without bihamates. B. R.

Ord. v. ECHINONEMATA.

Microciona atrosanguinea. G. M.
—— affinis. G. M.
—— quinqueradiata. G. M.
—— fascispiculifera. G. M.
Hymerhaphia eruca. G. M. and B. R.
—— unispiculum. G. M. and B. R.

Ord. vi. HOLORHAPHIDOTA.

Amorphina megalorhaphis, n. sp. B. R.
Esperia serratohamata. G. M.
Hymedesmia stellivarians. G. M. and B. R.
Cliona Warreni, n. sp. G. M.
Placospongia melobesioides. B. R.
Samus anonymus. G. M.
Thoosa socialis (with flesh-spicules). G. M.
Geodia ramodigitata. G. M. and B. R.
Stelletta euastrum. G. M.
—— crassicula, n. sp. B. R.
Corallistes verrucosa. G. M.
Discodermia aspera. G. M.
—— lævidiscus. G. M.
—— sinuosa, n. sp. G. M. and B. R.
—— sceptrellifera, n. sp. G. M.

Ord. viii. CALCAREA.

Leucortis indica, *Hackel.*

Specimens of Spongida from Bass's Straits.

Halisarca bassangustiarum, n. sp. (prov.).
Dysidea Kirkii, *Bk.*
Oceanapia (Desmacidon) Jeffreysii. The Australian variety *D. fistulosa*, Bk.
Echinonema typicum, n. sp.
Dictyocylindrus reticulatus, n. sp.
Halichondria plumosa. Variety.
Acanthella stipitata, n. sp.
Halichondria incrustans.
Spirastrella cunctatrix, *Sol.*
Latrunculia purpurea, n. sp.
Axos anchorata, n. sp.
—— fibulata, n. sp.
Tethya lyncurium, ? Cliftoni, *Bk.*
Leucetta ? primigenia, *Häckel.*

Besides the above there are more or less of the remains of many other species, once fine specimens, but now encased by calcareous Polyzoa, and more or less destroyed, as before mentioned.

EXPLANATION OF PLATE XVIII.

N.B. All the spicules are drawn to the scale of 1-12th to 1-1800th inch, except fig. 9, which is on the scale of 1-24th to 1-6000th inch, and the "more magnified" flesh-spicules in figs. 1 *h*, 2 *h*, 3 *e*, 4 *b*, and 5 *b*, which are on the scale of 1-12th to 1-6000th inch. Figs. 3 and 6 are of the natural size, and fig. 3, *a*, *b*, enlarged views of the former.

Fig. 1. *Discodermia sinuosa*, n. sp. *a–e*, transformation of the disk to the lithistid form; *f*, interlocking of the filigreed extremities in the fully developed spicule; *g*, flesh-spicule; *h*, more magnified view of the same.

Fig. 2. *Discodermia sceptrellifera*, n. sp. *a–e*, transformation of the disk into the lithistid form; *f*, interlocking of the filigreed extremities in the fully developed spicule; *g*, flesh-spicule; *h*, more magnified view of the same.

Fig. 3. *Axos anchorata*, n. sp. (nat. size), growing on a mussel-shell. *a*, magnified view of surface; *b*, the same of internal structure in the transverse section; *c*, vents; *d*, skeleton-spicule; *e*, flesh-spicule; *f*, the same, more magnified.

Fig. 4. *Axos fibulata*, n. sp. *a*, skeleton-spicule; *b*, flesh-spicule; *c*, the same, more magnified.

Fig. 5. *Latrunculia purpurea*, n. sp. *a*, skeleton-spicule; *b*, flesh-spicule, a sceptrellum; *c*, the same, more magnified.

Fig. 6. *Cliona Warreni*, n. sp., *in situ*. *a*, Melobesian nodule; *b*, porehead; *c*, vent; *d*, spicule.

Fig. 7. *Dictyocylindrus reticulatus*, n. sp. *a*, skeleton-spicule; *b*, flesh- or echinating spicule; *c*, the same, more magnified.

Fig. 8. *Acanthella stipitata*, n. sp. Skeleton-spicule.

Fig. 9. *Halichondria infrequens*, n. sp. *a*, skeleton-spicule; *b*, "tibiella" or subskeleton-spicule; *c*, flesh-spicule, bihamate; *d*, flesh-spicule, equianchorate, front and lateral views.

Fig. 10. *Rotalia arenacea*, n. sp. *a*, trochoid portion; *b*, flat rim.

XXXVII.—*Note on* Papilio nebulosus, *Butler.*

By Lionel de Nicéville.

In the Ann. & Mag. of Nat. Hist. 5th ser. vol. vii. p. 33. n. 2, pl. iv. fig. 3, Mr. A. G. Butler describes and figures a new *Papilio* from Darjiling under the name of *nebulosus*. The Indian Museum, Calcutta, has lately had presented to it, by Capt. G. F. L. Marshall, R.E. (to whom Mr. F. Du Cane Godman gave one of the specimens which had recently been purchased by him at Darjiling), a very similar (male) specimen. On the upperside it differs from *P. nebulosus* in the ground-colour of the whole of the fore wing being dull black, except that portion of it which is internal to the subbasal black band present in ordinary Sikkim specimens of *P. antiphates*, Cramer, and which in my specimen is sap-green instead of cretaceous white. In *P. nebulosus* there are said to be two pale belts: in my specimen there are a few grey scales on the portion of the wing corresponding to the interval between the first and second subbasal black belts in *P. antiphates*, as also on the interno-median area near the outer angle. The outer half of the second U-shaped mark, as also the submarginal band, is sap-green instead of white. The hind wing as in *P. nebulosus*. On the underside the fore wing is marked as in *P. nebulosus*, *i. e.* differs from the upperside in having the base, U-shaped markings, and submarginal band all of a deeper shade of green, and the inner margin, together with a large portion of the median area behind the third median nervule (in fact, just that portion of the wing which is covered by the hind wing when the insect is at rest with its wings closed over its back), ashy white. Hind wing as in Sikkim specimens of *P. antiphates*, except that the area between the middle and outermost black bands is thickly clouded, as if the bands bounding it had been "smudged" over it, with black scales; and the area beyond the discal series of rounded black spots is also more or less clouded with scattered black scales. The specimen therefore differs considerably from that upon which Butler has founded his *P. nebulosus*. In spite, however, of its many points of difference from *P. nebulosus*, and still more from *P. antiphates*, I am exceedingly averse to calling it a new species, being of opinion that it is, like the first-named species, only a melanoid variety of *P. antiphates*, or possibly rather a reversion to the primordial type of coloration of the entire *antiphates* group of *Papiliones*.

XXXVIII.—*The Male Eels compared with the Females.*

By C. Robin*.

The existence of sexual differences in the common eel (*Murœna anguilla*, L., *Anguilla vulgaris*, Rafinesque, Rondelet) is open to no doubt, at whatever period of the year the examination is made.

With very few exceptions all the eels described under the varietal name of *pimpeneau* or *pimperneau*, from the maritime pools and marshes (*glut-eel* of English authors†), with large prominent eyes, a short flat muzzle, a slender cylindrical body, with the back black, and the pectoral fins a little larger than in the river-eels, not exceeding 0·38 or 0·40 metre &c., are males. In a lot of Seine eels, having all the ordinary characters, one 0·45 metre long, like most of the others, was a male. I have never found males of greater length.

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* Translated from the 'Comptes Rendus,' February 21, 1881, pp. 378–383.

† The broad-nosed eel, *Anguilla latirostris*, of Yarrell.

Syrski gives 0·43 metre as the greatest length met with in the males that he observed.

The abundance of the *pimpeneaux* and their strongly marked characters may even lead us to say that there are few species of fishes in which the external sexual characters are so distinctive of the male in comparison with the female as in the Eels. Only the male does not quit the shores of the sea, except at the period of reproduction, to go to the bottom; whilst the female only goes to the sea, quitting the fresh water, temporarily and at the same period.

The dissection of eels 0·35 metre long, or thereabout, shows at the first glance, in all seasons, whether the animal is male or female. Instead of the well-known characters of the ovary, a continuous semitransparent ribbon, of a yellowish colour, folded like a frill, we see in the same place, with the same relations, the same differences of length to the right and left, and of diminution of breadth at the posterior extremity, the testis, a delicate narrow ribbon, more or less rose-coloured, or of a semitransparent grey tint, rarely whitish. It is formed of a series of flattened floating lobes, most frequently 2 millims. broad and of twice that length, the greatest thickness of which does not exceed 1 millim. out of the time of reproduction, with the inner surface convex and the other flat, the outer or free margin thin, rounded into a quadrant, the lobes all united at their base only by the deferent canal &c., and with independent and distinct lobules.

The peritoneal fold which envelops them, as is also the case with the ovaries, attaches them to the sides of the vertebral column and of the swim-bladder. In females of the same size it is a continuous ribbon, a centimetre or more in width, of a yellowish white colour, more or less opaque or semitransparent, that we find interposed in the same manner between the abdominal viscera and the corresponding portion of the ventral wall.

These differences between the male and female eel, perceptible at the first glance, are sufficient to enable them to be recognized; but it is necessary to ascertain them from the moment when there are males different from the *pimpeneau*, that is to say, having the external characters of the small or middle-sized females. These differences, moreover, are greater than those which exist between the ovary and the testis of the

*Murænæ** and of various other fishes; they may even be compared with those which exist between the testes and the ovaries in the Batrachia and Birds.

But these external sexual differences are only sufficient because they correspond to structural dissimilarities existing between the constituent elements of the internal organs, fulfilling the physiological function of male on the one hand, of female on the other, and this in spite of morphological, embryogenic homologies and of connexions which approximate the ovary to the testis. This is what histology shows incontestably.

The want of this determination of the minute structure of these organs has caused people not to give to the external characters (those of the *pimperneau*, for example) the importance they possess as belonging here to the male, elsewhere to the female, with the body more swelled and not so black, the head more produced, the eye smaller, &c. This gap has even prevented some anatomists from taking count of the external differences which, at all seasons, exist between the ovary and the testis, the differences of structure of which are also always perceptible under the microscope.

On the one hand, at any period of the year, the ovary shows its ovules, more or less developed, but like those of all other osseous fishes, and its loose cellular tissue, which may be reduced to a minimum towards the period of oviposition, or, on the contrary, become in part cellulo-adipose subsequently; the ovary also always shows the narrow projections or thickenings of the surfaces of its lobes, parallel to each other, resembling folds running from the adherent to the free margin, and passing the latter in the form of small blunt denticulations.

On the other hand, the lobulate testis, of firmer consistence, with a close cellular texture, without adipose cells, traversed throughout its whole extent by *seminiferous* or *testicular tubes*, or *cylinders*, which are flexuous, twisted, terminated cæcally at both ends, at least out of the breeding-season—that is to say, falling into the type of *canaliculate testes*, such as that of the carps.

The contents of these tubes, which answer to what are called *spermatic capsules* in the case of other fishes, render the testis opalescent whitish grey, instead of the reddish-grey tint which is usual when its vessels are congested, a fact connected with the absence of ovules more or less rich in yellowish oily drops. These contents render the male organ more or less white, and make it pass into the state of *milt* at the time of the production of spermatozoids.

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* See C. Robin "Sur le cœur caudal des Anguilles," Journ. Anat. Physiol. 1880, p. 597.

Out of the period of reproduction the seminiferous tubes are 0·08–0·09 millim. in thickness, cylindrical, twisted in various directions, and ramified once or twice. Some of them anastomose with their nearest neighbours. Their extremities are closed, rounded, with or without a slight inflation. For the most part one of the extremities is situated close to the surface of the organ, which is covered with a delicate peritoneal tunic. None of them is particularly directed towards the deferent canal, and none opens into the latter.

The flexuosities of the tubes, their volume, and their structure give to the tissue of the organ the characteristic arrangement and the aspect usually observed in the testicular tissue of the higher Vertebrata. It is only by an enormous dilatation at the breeding-season that we can imagine that these canaliculi arrive at the state of *seminal capsules*.

These tubes are immersed in a dense web of cellular tissue, without adipose vesicles, and of a thickness between the tubes about half that of the latter. The ramifications of the vessels coming from the base of the lobes run along by the tubes and form around each of their extremities, rounded at the surface of the organ, a circular mesh 0·08 millim. in breadth; these altogether constitute an abundant network. The examination of the entire lobe, before making thin sections, might lead one to suppose that these meshes circumscribe so many closed vesicles or seminal capsules, whilst we have to do only with the extremities of the seminiparous canaliculi.

By the assistance of Dr. Hermann, preparator of the course of histology of the Faculty of Medicine, I have been able to ascertain that these tubes are composed of a delicate proper wall (0·001 millim.), which is transparent and homogeneous, folds readily, and is strongly adherent to the exterior tissue. Their inner surface is uniformly-lined with a single series of regularly prismatic epithelial cells, with their outer surface or base polygonal, which separate easily from the wall and are attenuated at their inner extremity. They bound, in the direction of the axis of the tube, a narrow canal, which is often apparently closed, in consequence of the contiguity of these extremities of the bounding-cells. The latter, which are finely granular, contain a comparatively large hyaline nucleus without granules, with a brilliant yellow nucleolus. The cells which are immediately contiguous are broken by separation, giving to the preparing fluid an opaline or lactescent appearance; floating in it are their shining yellowish granules and their nuclei, which are set free, and may or may not become slightly irregular.

A deferent canal, about 1 millim. wide, with delicate walls, runs along the adherent inner or dorsal margin of each testis from one end to the other. These unite in a single cavity or *seminal vesicle* at the level of the cloaca. The seminal vesicle opens into the urethra by the genital pore, and by the urethra almost immediately into the cloaca. The wall of this spermiduct is at the utmost $\frac{1}{3}$ millim. in thickness. It is composed of an inner layer of longitudinal, and an outer one of circular fibres; both of these, at the base of the lobes and a little upon their outer surface, entangle their bundles with those of the envelope of the male organ. These layers are formed of cellular tissue evidently mixed with smooth muscular fibres.

A single series of small polyhedric epithelial cells lines the inner surface of the deferent canal. Adherent to the inner border of all the delicate testicular lobules, it is thus lodged within the peritoneal fold attaching the testis to the swimming-bladder and the upper part of the abdominal walls.

As will be seen, with regard to the determination of the male sex of the Eels, we had to compare the well-known female generative organs with their homologues in the numerous individuals or groups of individuals which have external characters somewhat different from those of the most widely-distributed of these fishes.

The absence of ova in the one set, their presence at all times in the others, $\frac{1}{10}$ to $\frac{2}{10}$ millim. in diameter, so easily ascertained, might have furnished a demonstration, even without the comparison of the structure of the organ without ovules with the testis of other fishes.

These comparisons ought certainly to have been made before any investigation tending to prove the existence of an exceptional hermaphroditism, or indeed before imagining, without any previous study of the evolution of the ovary, that the organ described as the testis is only an ovary which has not arrived at its complete development.

The testicular structure in the organ of certain eels which is the homologue of the ovary of the others being incontestable, all that has been said, even within the last few years, of this hermaphroditism, and of the resemblance in this particular between the Eels and the Serranidæ, need no longer be discussed.

We may add that in the *Murænæ* (*M. helena*, L.) the generative organs constitute no exception to what they are in other osseous fishes. The males of the Congers, or rather the place of their ordinary sojourn, alone remain to be discovered.

The sex being ascertained, the general facts regarding the reproduction of these Apodal fishes follows therefrom; and these facts do not differ from what they are in nearly all other fishes, the Salmons in particular. Only the propagative migration of the Eels taking place from the fresh waters to the sea, the mode in which oviposition is effected, the fecundation and hatching of the ova, are still unknown. The Salmons, behaving in a directly opposite fashion, we have been able, so far as they are concerned, to study and utilize all these physiological peculiarities.

The same causes have hitherto prevented our seeing the testes of the Eels as they are at their arrival at the state of *milt*, and observing their spermatozoids, notwithstanding the abundance of the males (or *pimpeneaux*). But the period of the descent of the females towards the sea (November) shows that it is in November and December that they ought to be studied. These, however, are the only two months during which I have as yet been unable to observe them. I have ascertained that in October there are as yet no fecundating elements, and that in January there are no longer any. In the Landes and other parts of the south no doubt, the ascent of the young fish taking place as early as the second half of December, instead of in March, as in the Channel, these investigations will have to be made as early as September or October. As to the return of the females from the sea to the fresh waters, this cannot be denied; in fact I have received from M. Dufourcet some female eels of the variety *sardias*, taken in January and February in the Adour at about 40 kiloms. from the sea, one half of which had the stomach filled with examples of *Eunice sanguinea* and *Doris*, which are exclusively marine invertebrates.

Except as regards the minute structural determination and the truly testicular nature of the organ homologous with the ovaries, the preceding anatomical data are not new. The want of this determination and of the observation of the spermatozoids is probably what has led to their not having hitherto been taken into consideration as they deserve to be.

Duvernoy (Cuvier, Anatomie Comparée, ed. 2, 1846, tome viii. p. 117) describes the ruffle-like type of the testis of the Lampreys and Eels, with the free margin festooned in lobules, shorter to the right than to the left, like the ovaries, &c. He adds:—"At the breeding-season we perceive in it an innumerable quantity of granulations or small spermatic capsules, the rounded form of which has often led to their being confounded with the ovules, at least in the Eels, in which, in reality, these capsules are of nearly the same size as the ovules; but the latter are distinguished by their oval form." The ovules are spherical, and not oval; but the other facts are fundamentally correct. It is also in error that Duvernoy adds (p. 133):—"The Eels and the Lampreys have no deferent canal, any more than an oviduct. Like the ova, their semen ruptures the capsules in which it has collected, and diffuses itself in the abdominal cavity, whence it is expelled in the same way as the ova." But he correctly describes the place of opening of the peritoneal canal, the ureters, &c.

Valenciennes thought that the external characters regarded as serving to establish specific division among the common Eels might be due to difference of sex, and that, for example, the *pimpeneau* (*glut-eel* of the English) was the male of the *plat-bec* (*grig-eel* of the English). Nevertheless he did not venture to assert that such was the case (Dict. d'Hist. Nat. 1867, tome i. p. 548).

Syrski (Sitzungsb. Akad. Wiss. zu Wien, Bd. lxxix. 1874) has described and figured the homologies between the flattened lobulated testes of the Eels and their ovaries, the absence of ovules in the former coexisting with their presence in the latter. He particularly made known the deferent canal and its cloacal opening, but without determining the characteristic testicular structure of the lobules.

Lastly, Dareste ('Comptes Rendus,' 1875, tome lxxxi. p. 159) fully confirmed these observations upon the *pimperneaux* as regards the external anatomical character of the male organ. Among the *pimperneaux* he notices some female individuals. The Indian *Anguilla marmorata* also furnished him with males.

XXXIX.—*On a Collection of Nocturnal Lepidoptera from the Hawaiian Islands*. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 333.]

Tortricidæ.

CHILOIDES, gen. nov.

Pædiscæ affine genus; differt autem palpis longioribus infra bene ciliatis, ciliis antice productis; capite piloso. Alæ posticæ ramis secundo et tertio medianis bene separatis, petiolo nullo.

This genus has the form and general aspect of *Pædisca*, with which it seems to agree in the neuration of the primaries; the neuration of the secondaries, however, differs in the separate emission of the second and third median branches; the head is clothed above with long coarse hair, much longer than in *Pædisca*; and the palpi are longer, more depressed, and with the second joint clothed below with a long projecting fringe of hair; the antennæ are normal. I have failed to discover any described genus answering to these characters.

25. *Chiloides straminea*, sp. n. (No. 101).

General coloration of a *Chilo*; somewhat similar to *Pædisca albidulana*: primaries stramineous with brown veins; costal margin dotted with black; subcostal area crossed by numerous abbreviated fine oblique black lines and dots; submedian area speckled with black dots, the most prominent of which form a little group below the end of the cell, and two oblique series of three each, the first at basal third, and the second just beyond the external third; a submarginal series of fine black points: secondaries shining silvery grey, fringe slightly stramineous, white towards the anal angle, with a slender subbasal testaceous line: body stramineous. Primaries below shining blackish brown, with pale buff costal border minutely and sparsely speckled with black; external border slightly stramineous, black-speckled; fringe stramineous, with a subbasal brownish line: secondaries shining creamy white, fringe as above: body pale creamy buff. Expanse of wings 9 lines.

One specimen. "Occurs on salt marshes near Honolulu."

Mr. Blackburn has sent a specimen (No. 95) of a species which I am unable to identify. It was taken "flying near the active crater of Mauna Loa, Hawaii; elevation 4000 feet." Whether this fact has any connexion with its condition I cannot, of course, say; but its abdomen is wanting, and the wings, if they ever possessed a pattern, have certainly lost it.

26. *Proteopteryx Blackburnii*, sp. n. (No. 132).

Primaries above ash-grey, clouded with cupreous brown; costal area crossed by numerous parallel regular oblique brown stripes; a broad angulated band close to the base and a second just beyond it, only indicated by the usual oblique stripes above the median vein, but below this vein strongly defined externally by broad brown stripes; a cupreous oblique band from the middle of the costa to the external angle; this band is abruptly elbowed, widened, and mottled with black from the middle to the inner (or dorsal) margin; apex black, crossed on the costal border by a triangular white spot divided by a slender transverse black line; two submarginal white dots close to the apex; disk between the apical patch and the elbowed band filled by a large semicircular silvery patch enclosing a grey ,-shaped spot crossed by black and cupreous lines; fringe traversed by parallel dark grey lines: secondaries greyish brown with cupreous reflections; fringe silver-grey, traversed near the base by a dark grey stripe: head and thorax whitish; abdomen dark grey. Primaries below fuliginous brown with cupreous reflections, costal margin from just before the middle spotted with white; fringe traversed, at the base and in the middle, by two slender whitish lines: secondaries shining silvery white, the apical half mottled with grey and with slight cupreous reflections; costal border crossed by abbreviated blackish striæ: body below shining creamy white. Expanse of wings 5½ lines.

Var. (No. 131).

The basal bands on the primaries decidedly blacker, the second band well defined and solid throughout; the area immediately beyond this band white, forming a well-defined quadrate spot at the centre of the inner (dorsal) border; otherwise similar. Expanse of wings 5 lines.

Two specimens. "Flying about low plants at Makawao, Maui."

Lord Walsingham kindly identified this for me as a second species of his genus; it comes nearest to the variety of *P. emarginana* figured at pl. lxxvi. fig. 3, of the "North-American Tortricidæ" (Ill. Typ. Lep. Het. iv.). His Lordship has also referred the two following species to their genera.

27. *Steganoptycha fœtorivorans*, sp. n. (No. 66).

Primaries above with the costal half, excepting the margin, slaty grey, inner or dorsal half, including the external area and fringe, silvery white; costal margin silvery white, spotted with black, some of these black spots elongated into oblique lines; a short longitudinal dash close to the base; an oblique abbreviated band at basal fourth and a second just beyond the middle, united at their inferior extremities by a cross band, blackish brown; a black spot and a diffused brown spot close to the external angle; three longitudinal, discal, minute black dashes in a curved series; apex transversely striated with black; fringe externally irrorated with grey: secondaries shining fuliginous brown, with a pale line at the base of the fringe: body pale brown, collar and tegulæ darker; abdomen with slight cupreous reflections. Wings below fuliginous brown with cupreous reflections, internal borders white with cupreous reflections; body below silvery white. Expanse of wings 6 lines.

Two specimens. "Occasionally taken by beating; also bred from a larva spinning together leaves of a tree unknown to me by name. The tree in question superficially resembles box; but the leaves are somewhat larger, and have a strong, rather unpleasant scent. Mountains of Oahu."—*T. B.*

28. *Phoxopteris rufipennis*, sp. n. (No. 109).

Primaries above rusty orange, blotched with ferruginous red and transversely striated with plumbaginous grey; costal margin white, crossed by numerous parallel oblique dark ferruginous striæ, behind and below which are parallel plumbaginous striæ; a short black dash placed longitudinally just before the middle of the interno-median area; a transverse sprinkling of black scales between the two last grey striæ upon the disk; fringe grey, blotched and tipped with rose-red, and with a pale basal line: secondaries fuliginous brown, with slight violet reflections; fringe whity brown towards the apex, but grey towards the anal angle, and with a black subbasal line: head and thorax ferruginous red; abdomen blackish, ferruginous at the base. Wings below greyish brown, shot with purple: primaries with the costal margin dotted with stramineous; outer margin slenderly white; a very slender blackish marginal line; fringe dark greyish brown, tipped with red-brown, and with a white basal line; apex dark red-brown: secondaries shining grey, whitish at apex, and with a brown subbasal line. Body below cream-coloured; palpi and anterior legs above orange. Expanse of wings 4½ lines.

One specimen. "Beaten from the 'Koa' tree singly on two or three occasions. In specimens not absolutely fresh the white markings on the wings are obscure, approximating to the ground-colour. Taken on Oahu."—*T. B.*

Tineidæ.

29. *Blabophanes longella* (No. 68).

Tinea longella, Walker, Cat. Lep. Het. xxviii. p. 479 (1863).

One specimen. Honolulu.

The type of this species was from Northern India; and a second example from South Africa was recently recognized by Lord Walsingham among specimens of Micro-Lepidoptera, taken by Mr. Gooch, and now forming part of the collection of the South-African Museum. The only difference between these specimens (apart from size) is in the colour of the head, which in the African specimen is distinctly orange-yellow, in the Indian one pale yellow, and in the Hawaiian one (which is also slightly smaller than the two others) nearly pure white.

B. longella is nearly allied to *B. monachella* of Europe, but unquestionably distinct.

30. *Blabophanes rusticella* (No. 110).

Tinea rusticella, Hubner, Samml. eur. Schmett. v. fig 335 (1827).

One specimen. Honolulu.

31. *Blabophanes obumbrata*, sp. n. (No. 71).

Primaries above black-brown, with cupreous reflections; a large patch of greenish testaceous occupying nearly the whole of the basal two thirds excepting at the borders of the wing, and enclosing four black spots in a rhomboidal form—one large, hastate, and within the discoidal cell, the second smaller, triangular, at the end of the cell, the two others small and oval upon the interno-median area; outer border narrowly whity brown, speckled with blackish; fringe grey, pale brown at the base: secondaries grey, with cupreous reflections: body testaceous; head and thorax mottled with black. Under surface fuliginous brown, shining, with slight cupreous reflections; primaries shot with purple. Expanse of wings 7½ lines.

One specimen. "Occasionally taken in Honolulu."

Gelechiidæ.

32. *Depressaria usitata*, sp. n. (No. 69).

Primaries above dark shining fuliginous brown; a fusiform black spot at the base, a rounded spot at the middle, and a transverse spot at the end of the cell; a slender whitish or pale line at the base of the fringe, followed by a darker line: secondaries silvery grey, with slight cupreous reflections; fringe traversed by a dusky line and with dusky tips: thorax above shining fuliginous brown; abdomen greyish brown, with cupreous reflections. Under surface pale shining silvery brown; costal borders and external border of primaries testaceous mottled with grey. Expanse of wings 1 inch.

Two specimens, probably from Honolulu; but the exact habitat is not given. Mr. Blackburn says, "I have a single specimen (? ♂) with the antennæ thicker than in those sent, and obscurely pectinated, as in one of the specimens of 73." This species seems to be most nearly allied to *D. badiella*.

33. *Depressaria gigas*, sp. n. (No. 119).

Primaries above shining fuliginous brown*, irrorated with black, especially upon the borders; a paler diffused transverse discal band, not reaching the costal or dorsal margins, limiting the external border; an irregular black spot beyond the middle of the cell, and an irregular transverse black bilobed spot on the discocellulars: secondaries paler than the primaries, with a narrow diffused testaceous border spotted with blackish at the extremities of the veins: thorax dark fuliginous brown; antennæ grey; palpi testaceous, black-speckled, with black terminal joint; abdomen whity brown, banded with blackish. Primaries below shining fuliginous brown; the apical half of costal border, the outer border, and external margin of the fringe irrorated with whity brown: secondaries whity brown, densely irrorated with fuliginous brown, excepting on the abdominal border, most densely towards the costal margin; a marginal series of blackish spots as above: body below creamy testaceous or pale buff, the legs more or less irrorated with black scales, venter with lateral series of black spots. Expanse of wings 1 inch 11 lines.

One specimen. "Three specimens taken; one was at sugar, the other two at light; all at about 4000 feet up Haleakala, Maui."

This enormous species seems to belong to the same group as the preceding one; it perfectly agrees with *Depressaria* in all details of structure, notwithstanding its greatly superior size.

The three following species agree in general character with Walker's genus *Chezala*, which (notwithstanding that its affinity to *Depressaria* is noticed in the description) stands near the end of the family in Walker's Catalogue. The only structural difference which I have detected between this genus and *Depressaria* is in the slightly different branching of the median nervules of the secondaries, the second and third nervules being emitted from a short footstalk instead of from the inferior extremity of the cell. This character however, does not, appear to be constant; and to insist upon it would separate some of the unquestionably most nearly allied species, including those which, in pattern, correspond with Walker's type.

34. *Depressaria indecora*, sp. n. (No. 128).

Apparently nearest to *D. libanotidella*, but with wider secondaries: primaries above testaceous irrorated with white,

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* Seen under a lens it is really yellowish clay-colour, but densely speckled with black.

and speckled here and there with black, especially along the inner or dorsal margin; costal border regularly spotted with black from the middle to the apex, and forming a continuous series, with six or seven spots on the outer margin; an oblique irregular black basicostal dash; a group of black spots across the discoidal cell, just beyond its centre; a black transverse spot at the end of the cell, a subconfluent angulated series of longitudinal black dashes immediately beyond the cell, and a second series of distinct black dashes halfway between the latter and the outer margin; fringe pale, with grey tips and blackish spots in continuation of the black marginal spots: secondaries brownish grey; fringe pale testaceous, with the tips and a subbasal line dark grey, a slender white basal line: thorax testaceous, speckled with black; abdomen dark grey, with the hind margins of the segments and anus golden buff. Under surface sericeous grey: wings with blackish-spotted yellowish fringes, but appearing glossy grey in certain lights; primaries with black-spotted testaceous costal border: secondaries paler than the primaries, having a silvery aspect: body below silvery, like the secondaries; legs dark brown above and banded with whitish, below whitish. Expanse of wings 11½ to 12½ lines.

"At an elevation of 4000 feet on Haleakala, Maui. Generally started off rotten trunks and stumps of trees. Two specimens."—*T. B.*

35. *Depressaria lactea*, sp. n. (No. 129).

Primaries above cream-coloured, more or less densely speckled with testaceous on the borders, and with black markings, nearly as in the preceding species; base occupied by an irregular black stripe; a Σ-shaped black marking across the cell and a 7-shaped black marking at the end of the cell; an ill-defined arched series of subconfluent dusky dashes immediately beyond the cell, followed by an arched subconfluent series of longitudinal blackish dashes; apical half of costal margin and external margin regularly spotted with black; fringe white, indistinctly spotted with grey: secondaries silvery white, speckled with grey, especially on the disk, where the greyish irroration forms a broad belt; a slender interrupted subbasal line on the fringe, which is also spotted with grey: head and thorax cream-colour; antennæ and terminal joint of palpi blackish; abdomen silvery. Primaries below cream-coloured, mottled with grey, excepting on the costal and internal borders; marginal black spots rather less sharply defined than above, but quite distinct: secondaries shining silvery white, costal border with creamy yellowish reflections; fringe as above: pectus and legs cream-coloured, the latter banded with brown above; venter pure white. Expanse of wings 1 inch 4 lines.

"In company with No. 128. I bred a specimen of each of them from pupæ found (not together) in rotten wood." One specimen.

Notwithstanding the similarity of pattern and habit between this and the preceding species, *D. indecora* possesses the true neuration of *Depressaria*, and *D. lactea* that of the arbitrary group *Chezala*. The following also agrees with the latter group.

36. *Depressaria argentea*, sp. n. (No. 100).

Silvery white: primaries irrorated with grey; markings almost exactly as in *D. indecora*; an oblique basicostal black dash; base of dorsal margin grey; a black dot in the cell and an angular >-shaped group of spots below it; a bilobed black transverse spot at the end of the cell; two arched discal bands formed of more or less confluent grey dashes; apical half of costal margin and outer margin spotted with black: secondaries with grey spots on the fringe: female with the terminal segments of the abdomen banded with grey. Primaries below yellowish (like pale gold), the marginal black spots as above; secondaries with slightly yellowish costal area, otherwise white: body below white; legs banded above with greyish. Expanse of wings 7–11 lines.

A pair of this pretty little species. Mr. Blackburn says that it was taken on the "mountains near Honolulu."

37. *Parasia sedata* (No. 86).

♀. *Gelechia sedata*, Butler, Cist. Ent. ii. p. 560. n. 88 (1880)

The male of this species, which agrees better (both in structure and pattern) with *Parasia* than with *Gelechia*. It was taken "flying on the sea-shore at Kawaihae, Hawaii."

HYPOSMOCHOMA, gen. nov.

Holcoceræ affine genus. Alæ posticæ vena mediana triramosa, ramis autem omnibus bene separatis, *petiolo haud emissis*; *fasciculo setarum magno basali*; ciliis marginis externi longissimis; palpis perlongis, arcuatis, a latere emissis; capite lanuginoso; antennis longis, crassis; podibus longis, robustis, tibiis valide spinosis.

The principal differences between this genus and *Holcocera* seem to consist in the branching of the median vein of the secondaries, the second and third branches being emitted separately instead of from a footstalk; and in the large fascicle of bristles emitted from the base of these wings (presumably a scent-fan), which, when closed, extends along the costal border to some distance beyond the end of the cell, but when opened extends obliquely backwards across the secondaries, and forwards across the under surface of the primaries: the frons appears (judging from the description by Clemens) to be narrower than in *Holcocera*; but in other respects the two genera seen to be much alike*.

Hyposmochoma has somewhat the aspect of *Butalis*, excepting for its singularly placed palpi, which are emitted almost as far apart as in my New-Zealand genus *Boocara*.

38. *Hyposmochoma Blackburnii*, sp. n. (No. 123).

♂. Primaries dark sepia-brown, the second and third sixths of the costal half densely sprinkled with cream-coloured scales, forming a large oblong patch, sharply defined and oblique at its basal extremity, but diffused externally; rather beyond the middle of this pale patch is a short longitudinal black subcostal spot; a few scattered creamy or pale testaceous scales on the basal area; a patch of white and pale scales on the dorsal margin near the external angle; a transverse subapical white belt, notched internally, angulated and expanded upwards along the outer margin externally, and enclosing one or two marginal black spots; a central longitudinal, slightly branched, black streak almost from the base to the white belt; apex black, crossed by two transverse spots of whitish scales; costal fringe immediately opposite to the commencement of the subapical belt pale golden or shining whity brown; fringe of outer margin of the same colour, but tipped and traversed by grey lines, and with two or three black spots upon the inner line: secondaries grey, with bronzy reflections and bronze-brown fringe; the pencil of hairs or bristles stramineous: thorax black, the head and fringes of the tegulæ pale bronzy brown; palpi with silvery inner margin: abdomen dark greyish brown. Wings below shining plumbaginous grey, with slight cupreous reflections, fringes paler than above: body below pale metallic golden; legs brown above, the tarsi black, banded with cream-colour, tibial spines cream-colour. Expanse of wings 9 lines.

One specimen. "Occurring at about 4000 feet above sea on Haleakala, Maui; various localities. I think it is connected with dead wood."

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* I again have to thank Lord Walsingham for referring me to the description of *Holcocera*; without this reference I should have been much puzzled as to the affinities of this singular insect.

Genus CHRESTOTES (= *Safra*, Walk.).

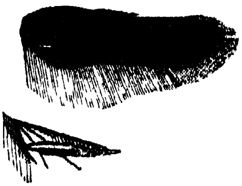
Walker founded a genus under the name of *Safra* upon a species of Crambid from Shanghai (Cat. Lep. Het. xxvii. p. 195, 1863); he subsequently gave the same name to one of the genera of Gelechiidæ (Cat. Lep. Het. xxix. p. 785, 1864); the latter therefore requires a fresh denomination.

39. *Chrestotes dryas*, sp. n. (No. 70).

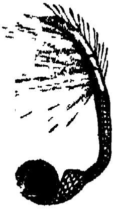
Primaries above pinky clay-coloured, mottled all over with grey; these mottlings are most regular along the borders, but are evidently not arranged on any plan, as they do not correspond on the opposite wings; fringe whity brown, irrorated and obscurely spotted with grey*: secondaries silver, with a tarnished appearance; fringe pale testaceous: thorax reddish clay-coloured; abdomen greyish brown. Under surface bronzy brown, shining: secondaries greyish towards the anal angle; body pale. Expanse of wings 9½ lines.

One specimen. Honolulu.

1.



2.



EUPERISSUS, gen. nov. (Fig. 1, hind wing.)

Tarudæ affine genus. Alis angustis elongatis, venis parallelis: alæ anticæ margine costali modice arcuato, ciliis longulis; vena costali perlonga; vena subcostali triramosa, ramo primo venæ medio emisso, secundo et tertio apud angulum cellulæ anticum emissis; vena superiore radiali furca terminali instructa; vena inferiore radiali simplici; vena mediana triramosa, ramis secundo et tertio approximatis: posticæ margine costali paululum concavo, ciliis apud apicem plicatis, venis omnibus bene separatis, ramis duobus subcostalibus paululum divergentibus; vena mediana supra late ciliata, ciliis regularibus rigidis, penicillum elongatum ruga abdominali emissum partim obtegentibus et inhibentibus; ciliis ordinariis longulis; capite lato leviter cristato, antennis longis modice pectinatis, palpis perlongis arcuatis; pedibus robustis, posticis perlongis, tibiis supra setosis, infra inæqualiter quadrispinosis.

This extraordinary form comes nearer to *Taruda* of Walker than to any other genus: it doubtless belongs to the group of genera allied to *Cryptolechia*; the singular development of bristles from the median vein of the secondaries, in order to hold down a long hair-pencil which proceeds from the marginal abdominal furrow, is one of the most singular contrivances which I ever observed in a Lepidopterous insect.

40. *Euperissus cristatus*, sp. n. (No. 72).

Primaries above pale shining bronze-brown, with a black spot at the end of the cell, a grey dot near the middle of the cell, one or two (very indistinct) near the base, and one about the middle of the interno-median area: secondaries silvery grey, with the cilia from the median vein and the pencil from the abdominal fold bright ochreous; marginal fringe pale brown, spotted obscurely with grey at the base: head clay-brown; thorax silvery; abdomen pale buff; basal joint of antennæ blackish, remainder of antennæ and palpi cream-coloured. Under surface shining silvery, metallic; legs and base of venter pale buff. Expanse of wings 11½ lines.

One specimen. Mountains near Honolulu.

STŒBERHINUS, gen. nov. (Fig. 2, palpus.)

Urbaræ affine genus, *Ypsolopho*[*] simile, differt autem palpis maris permagnis crassis, scopis terminalibus expansis, feminæ palpis simplicibus longulis porrectis; antennis crassis.

The development of the male palpi in this genus is considerably greater than in the little South-American genus to which Walker has given the name of *Urbara*; this organ curves upwards far above the head in *Stœberhinus*, and is broadly fringed at the back, so as to present the appearance of a hearth-broom[†].

41. *Stœberhinus testaceus*, sp. n. (No. 73).

Primaries above pale testaceous; six dark brown spots arranged in pairs, two at the base, two just beyond the basal third, the fifth (which is largest) just below the end of the cell, and the sixth in an oblique line with it on the dorsal margin; two or three widely-separated brown costal spots and an arched series close to the outer margin; a slender brown marginal line, and a paler line near the base of the fringe, beyond which it (the fringe) is almost pure white: secondaries silvery white, with faint cupreous reflections; an indistinct marginal testaceous line: body testaceous; palpi with the terminal bristles dark brown; abdomen silvery at the base. Primaries below greyish testaceous, with a narrow buff-coloured border; fringe silvery: secondaries with greyish testaceous costal area, otherwise as above: body below shining golden buff. Expanse of wings 6 lines.

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[*] *Y. verbascellus* especially.

[†] The development is quite different from that in *Anaphora*, being quite slender and only emitting divergent bristles from the back of the last joint.

A pair. Honolulu.

Argyresthiidæ.

42. *Argyresthia zebrina*, sp. n. (No. 74).

Primaries above stramineous; two black spots placed obliquely near the base on the costal and dorsal margins, two larger spots at about the basal third, almost uniting in the centre into an oblique band; an oblique irregular abbreviated band across the end of the cell, divided by a longitudinal line of the ground-colour at its inferior extremity, and beyond this four submarginal black dots; a broad oblique black subapical band, divided by a slender line of the ground-colour close to its outer edge; fringe white at apex, but interrupted by a large black spot confluent with the subapical band, and emitting a short curved line outwards and downwards close to the edge of the fringe: secondaries silvery white, slightly tinted with stramineous towards the apex: body ochraceous, frons black. Under surface shining grey: primaries with cupreous reflections. Expanse of wings 4 lines.

One specimen. Honolulu.

43. *Argyresthia? aurisquamosa*, sp. n. (No. 42).

Primaries coarsely scaled; brown, changing to purple in the light, and with the scales beyond the middle metallic golden in the centre; an irregular sulphur-yellow spot at about the centre of the dorsal margin, and a cuneiform subapical costal spot sulphur-yellow, changing in the light to brassy gold; fringe pale bronzy brown: secondaries bronzy brown, with the basicostal area and outer margin metallic silver; fringe very long and bronzy brown: thorax dark brown, shot with purple and spotted with gold; frons, palpi, and antennæ bright pearly opaline; abdomen greyish brown; legs whitish; tarsi obscurely banded with grey. Wings below bronzy brown: secondaries paler than primaries: body shining whity brown. Expanse of wings 5 lines.

One imperfect specimen. I have taken the description from two specimens previously sent. "Occurs in neighbourhood of Honolulu."

Gracilariidæ.

44. *Gracilaria inana*, sp. n. (No. 112).

Allied to *G. rufipennella*. Primaries above pale brown, densely irrorated with darker brown, general coloration pale smoky brown; in certain lights a faint pink reflection; a blackish dot in the middle, and a second at the end of the cell; a line of dark brown scales from the second spot to the costa, and thence along the margin to apex; four ill-defined dark brown marginal dots between the apex and the first median branch; fringe whity brown, with cream-coloured basal line and a subbasal series of darker brown flecks: secondaries with the basal third silvery white, the remainder pale shining brown; fringe whity brown, with cream-coloured basal line: head and prothorax pale brown; frons white, vertex of head and basal joint of antennæ buff, remainder of antennæ grey; meso- and metathorax and abdomen pearly grey, anal tuft shining stramineous; legs above brownish, indistinctly banded with grey. Wings below shining bronze-brown: body whitish, tinted with yellow towards the anus. Expanse of wings 6½ lines.

One specimen. Honolulu.

45. *Gracilaria auripennis*, sp. n. (No. 121).

Primaries above golden ochraceous, with orange fringe: secondaries smoky black: head and palpi opaline; antennæ above black, banded with white, below cream-coloured; thorax ochraceous; abdomen black. Primaries below shining fuliginous brown, with bright ochreous costal margin and fringe: secondaries silvery, with brown fringe: body below and legs brilliant pearly white. Expanse of wings 6 lines.

One specimen, "beaten from 'Koa' trees (a species of *Acacia* I believe) on Haleakala, Maui" (*T. B.*).

Elachistidæ.

46. *Laverna abjecta*, sp. n. (No. 48).

Allied to *L. conturbatella*. Primaries dark fuliginous brown; a whitish spot at the base; an angulated cream-coloured band across the basal fourth; a rather wide bluish-white streak along the dorsal margin from the angle of the subbasal band to the external angle of the wing; the inner edge of this streak is bisinuate, with a cream-coloured spot at the point between the sinuations; apical fourth densely irrorated with bluish white, with the exception of a spot at apex and a hastate spot on the outer margin; costal fringe and basal half of external fringe olive-brown, spotted with white, outer half cream-colour, tipped with grey: secondaries silvery grey, with the fringe pale brown at the base: head brown; palpi black and white; antennæ black; pro- and mesothorax black; metathorax and abdomen pale brown. Primaries below pale bronze-brown, with golden costal border; fringe crossed by a whitish stripe: secondaries silvery whitish, with brownish costal border and fringe: body below pearly whitish. Expanse of wings 7½ lines.

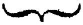
One specimen, which came in a former collection, but which I now venture for the first time to describe.

47. *Laverna corvina*, sp. n. (No. 122).

Primaries above sericeous jet-black; an oblique cream-coloured band at basal fourth continuous with an internally bisinuated streak of the same colour, which extends along the dorsal margin to the external angle, and then emits a rather yellower abbreviated band upwards close to the outer margin; a cream-coloured costal spot at apical fourth; fringe smoky black: secondaries silvery grey, with smoky-brown fringe; a jet-black pencil of hairs from the base of the costa: head dark green and golden; palpi blue-black, the joints tipped with whitish; antennæ black; collar golden; pro- and mesothorax black; metathorax testaceous; abdomen prismatic grey; legs black, banded with opaline white. Wings below shining grey; fringe brownish; pectus bright silvery; posterior legs below and venter bright golden opaline. Expanse of wings 7 lines.

Two specimens, "beaten from 'Koa' trees on Haleakala, Maui."

48. *Laverna domicolens*, sp. n. (No. 124).

Primaries above brownish grey, with slight pinky reflections; an irregular almost -shaped black-brown band from the base of costa, through the centre of the wing, to the apical third of costa; a black costal spot opposite to the centre of this band; three blackish costal dots towards apex; external angle suffused with brown; fringe whitish beyond the centre: secondaries metallic silvery, with pale bronze-brown fringe: body on both surfaces pearly white; tibiæ and tarsi banded with black. Wings below shining silvery, the primaries appearing tarnished towards the apex and on the fringe. Expanse of wings 6 lines.

Two specimens, "occurring at Makawao, Maui; about 2000 feet above sea, in a house."

49. *Laverna parda*, sp. n. (No. 125).

Primaries above slaty grey, irrorated with black; the base, a streak along the dorsal margin, a streak across the cell, a spot on the costa near apex, and a spot at external angle densely sprinkled with white scales; a black spot at the base, two in the cell, a rather large one closing the cell, and two below the cell; fringe and the whole of the secondaries sooty grey: thorax black, spotted with ochreous; frons cream-coloured; abdomen grey, with pale margins to the segments; legs above black, banded with white, below white. Wings below shining plumbaginous grey, with dull grey cilia: body below silvery white. Expanse of wings 6 lines.

Var. (No. 127).

Smaller; the primaries much more generally irrorated with white, so that the black spots stand out more prominently; the secondaries plumbaginous instead of sooty grey, and with brown cilia; body paler; the head greyish white or creamy yellowish, with white frons and almost wholly white palpi; the black colouring of the upper surface of the legs variable (in the paler specimen reduced to a series of spots). Expanse of wings 5½ lines.

Three specimens, the typical one taken "on Haleakala, about 4000 feet above sea; apparently connected with dead wood." The two others "at light, Makawao, Maui."

One of the specimens taken at Makawao is exactly intermediate, excepting in size, between the two other specimens sent by Mr. Blackburn; and as the arrangement of the most stable character (that is, of the black spots on the primaries) is the same in all three, I cannot think that we have here more than a variation to deal with.

50. *Chrysoclista tigrina*, sp. n. (No. 120).

Primaries above golden orange; basicostal area dusky; discoidal cell black, crossed near the middle by two oblique lines of the ground-colour, and only separated by a third oblique line from a little curved black stria at the end of the cell; an oblique blackish costal streak above the end of the cell, immediately followed by a similar white streak; an almost fusiform apical costal black patch, partly crossed by two silvery-white tufts of scales, and bounded externally at apex by a third; a broad silvery-white longitudinal median stripe from the base almost to the end of the cell; base of dorsal border dusky; five confluent black dots along the outer margin, the fourth bounded internally by a white dot; apical half of fringe golden orange, longitudinally striped with white, the dorsal half smoky brown; two longitudinal black dashes close to the external angle: secondaries silvery grey, with fuliginous brown fringes: head, thorax, and palpi pearly white; abdomen blackish. Wings below silvery grey, with slight bronzy reflections; apical half of fringe of primaries orange, remainder of fringe brown: body below white. Expanse of wings 5 lines.

One specimen, "beaten from 'Koa' trees on Haleakala."

51. *Chrysoclista? haleakalæ*, sp. n. (No. 126).

Primaries above black, sericeous, with slight purplish reflections; a few golden-orange scales at the middle of the costal border, and a large spot of this colour above the end of the cell; a broad orange longitudinal stripe running along the median vein from the base to the end of the cell; a spot at external angle; cilia orange at apex: secondaries smoky black, with slight pinky reflections, the cilia dull: head and thorax orange; frons golden opaline; abdomen slaty grey, with fiery cupreous reflections. Wings below smoky brown, shining, with bronzy reflections; primaries with silvery inner border: body below shining metallic silvery, the tibiæ and tarsi blackish above. Expanse of wings 6 lines.

Two specimens. "On Haleakala, in company with *Laverna parda*."

Pterophoridæ.

52. *Platyptilia repletalis* (No. 96).

Platyptilus repletalis, Walker, Cat. Lep. Het. xxx. p. 931. n. 16 (1864).

One specimen. "Mauna Loa, Hawaii, elevation about 4000 feet."

53. *Amblyptilia cosmodactyla*, var. (No. 137).

Alucita cosmodactyla, Hubner, Samml. eur. Schmett. 5, figs. 35, 36 (1827).

One specimen. "Not rare at light; also by beating, at an elevation of about 2000 feet, on Haleakala, Maui."

54. *Aciptilia hawaiiensis*, sp. n. (No. 138).

Wings above sericeous whity or sandy brown: primaries paler than the secondaries, but with dark brown costal border; a black dot just above the commencement of the cleft between the lobes; anterior lobe fuliginous brown, crossed near its base by an oblique white band, and towards the apex by two obliquely-placed white dots; fringe at apex white; posterior lobe fuliginous brown externally; fringe spotted here and there with white, that of the inner margin with a black dot near the commencement of the cleft, and black spotted with white towards the external angle: secondaries with greyish cilia; a black spot at the second third of the abdominal fringe: metathorax, base of abdomen, and hind margins of the segments white; legs banded above and below with white. Wings below darker than above: body below white. Expanse of wings 6 lines.

Two specimens. "Common on the sea-shore at Uoluolu, Maui" (*T. B.*).

XL.—*Descriptions of two new Longicorn Coleoptera and a new Genus of* Dynastidæ. By CHARLES O. WATERHOUSE.

Lamiidæ.

Megacriodes Forbesii, n. sp.

Niger, nitidus, pube subtilissima cinerea indutus; thoracis disco macula oculata crocea ornato; elytris basi et sub humeros crebre granulosis, plagis sex albis ornatis.

Long. 22 lin.

Near to *M. Saundersii*, Pascoe (Trans. Ent. Soc. 3rd ser. iii. p. 272, 1866); but, judging from the figure (pl. xii. fig. 1), it is a more robust species. It differs chiefly in having the base of the elytra and all the humeral region thickly studded with shining granules. The scutellum is yellow. Each elytron has three patches of white pubescence (which were doubtless yellow when the insect was alive)—the first and second placed as in *M. Saundersii*, but very irregular in form; the third very elongate, and as if formed of the two apical spots of *M. Saundersii*. The underside is clothed with yellowish-grey pile, with a broad stripe along the side from behind the eye to the apical segment of the abdomen; this stripe is part yellow and part white; it was probably yellow when the specimen was alive.

Hab. Lampong, Sumatra (*H. O. Forbes*). B.M.

Pœmenesperus Dobræi, n. sp.

Niger, velutinus, griseo variegatus; antennarum articulo tertio basi apiceque testaceo, articulis sex apicalibus flavis.

Long. 8 lin.

Near *P. voluptuosus*, Th. (Arch. Ent. i. pl. vi. fig. 6), but with the lateral angle of the thorax much nearer the base. Antennæ with the base and apex of the third joint and the extreme base of the fourth pale; half the fifth and all the sixth to tenth joints yellow; the eleventh is yellow, except at the extreme apex. Head black; the face, a central line, a patch behind, and a dot above each eye pale grey. Thorax black, with a line along the anterior margin, another at the base, an irregular line over the lateral spine, and a Λ-shaped mark on the disk grey. Elytra at the base a trifle broader than the thorax, with obtuse but prominent shoulders, black, with a transverse grey band at the base; this descends a little at the suture, dentate along its basal line; at the middle there is a grey line which, commencing on the margin, extends to the middle of the elytron, where it ascends a little, and then turns at right angles towards the suture, where it again descends for some distance and is united to another band, which leads back to the original point on the margin. At some distance from the apex there is an oblique grey band which nearly reaches the suture and then descends to the apex, emitting a small branch about halfway to the apex; there is also a grey spot on the margin close to the apex. The underside and legs are grey, dotted with black.

Hab. Gaboon. B.M.

I have only seen one specimen of this elegant species. I have named it after its captor, the late Robert B. Dobree, Esq.

Dynastidæ.

BRACHYSIDERUS, n. gen.

General form and characters of *Antedon*. Thorax in the male evenly convex and without tubercle or horn. Ocular canthus with its anterior angle directed forward into a short sharp tooth. Horn on the clypeus a little longer than the head, thick, horizontal, dilated at the apex, which is emarginate, the angles acute and turned slightly upwards. Legs much more robust and more flattened than in *Antedon*, smooth; the anterior tibiæ broad, with three strong acute teeth near the apex; the claw-joint of their tarsi considerably enlarged, with a strong tooth about the middle; one claw much larger than the other, suddenly bent before the middle, with a strong acute tooth at the base. Intermediate and posterior tarsi with the basal joint short and produced on the outer side into a long acute spine. Body above and below smooth and without pubescence.

This genus should be placed between *Antedon* and *Mitracephalus*, differing from both in the absence of horn on the thorax.

Brachysiderus quadrimaculatus, n. sp.

Piceus, nitidus; thoracis lateribus flavescentibus macula picea notatis, elytris testaceis, punctulatis, sutura maculisque quatuor piceis. ♂.

Long. cornu excl. 14 lin., lat. 8 lin.

Head pitchy black, nearly impunctate; the horn deeply excavated at the base. Thorax convex, very much rounded at the sides, very thickly, finely, and delicately punctured, the posterior angles obtusely rounded. Elytra a little broader than the thorax, smoky testaceous, not very thickly punctured; the suture broadly and the margins very narrowly pitchy; each elytron has a pitchy black spot on the shoulder and another near the apex.

Hab. Amazons.

This species will be figured in the sixth part of my 'Aid to the Identification of Insects.'

XLI.—*Description of a new Species of the Coleopterous Genus* Dryops *from Pekin* (*Family* Parnidæ). By Charles O. Waterhouse.

Dryops sericatus, n. sp.

D. substriato affinis et similis, magis tamen elongatus; thorace postice paulo angustato, lateribus marginatis fere rectis, ad angulos anticos solum arcuatis.

Long. 3 lin.

This species has the colour and appearance of *D. substriatus*, but is much more elongate and relatively narrower. The most striking difference is in the form of the thorax: this is very little transverse, distinctly narrowed posteriorly, much narrower at the base than the elytra, moderately convex on the disk; the anterior angles are moderately prominent and acute; the sides are distinctly margined, broadly so in front, as if impressed above the anterior angles; rectilinear, except near the anterior angles, where they are gently arcuate. The elytra are less convex, rather more straight at the sides; the striæ are scarcely so well marked; and the punctuation of the interstices is finer. The legs are very long, pitchy.

Hab. Pekin. B.M.

XLII.—*Description of a new Cornuted Species of* Cetoniidæ *from North-eastern India.* By J. Wood-Mason, Deputy Superintendent, Indian Museum, Calcutta.

[Plate XVII. figs. A, B, C.]

Mycteristes microphyllus, n. sp.

♂. Slender. Above obscure bronzy, with dull greenish reflections, and sparsely clothed with minute whity brown appressed squamiform setæ; legs and under surface more brilliant and redder bronzy, without green reflections, but with a similar clothing of setæ, which are longer and denser on the thorax; exposed outer ends of abdominal terga densely clothed with whity brown setiform scales; tarsi black. Clypeus concave, with its anterior angles pointed, produced, and somewhat divergent; its front margin armed with a short and broad-stalked small subcrescentic process, which is slightly transversely concave behind and correspondingly convex in front. The crown of the head produced horizontally over the clypeus into a short, truncated, triangular, lamellar process, divided at its extremity into two rounded points by a median notch. Pronotum unarmed. Mesosternal process very short, porrected in front, not produced downwards beyond the level of the sternum. Abdomen grooved along the middle below. Fore tibiæ externally tridentate; four posterior ones bidentate, as in *M. rhinophyllus.*

Length from extremity of cephalic horn to end of abdomen 19 millims.; breadth across bases of conjoined elytra 7·75 millims.

While I was in England on furlough in 1877–78, Mr. E. W. Janson showed me an insect which I at once recognized as the female; it differs from the male in having the clypeus, as in *M. rhinophyllus*, simple, but, as far as I recollect, in no other point of any moment.

From the Javan *M. rhinophyllus* the present species differs in the small amount of sexual differentiation it has undergone (the pronotum being hornless, and the colour and general form the same in both sexes, and the azygous horn on the front of the clypeus in the male being short and inconspicuous), in having the mesosternal process directed forwards instead of downwards, in colour, in its slenderer form, and probably also in the crown of the head in the male being produced into a bilobed horizontal plate-like process overhanging the clypeus.

Hab. The specimen was presented to me several years ago by my friend and colleague Mr. Geoffrey Nevile, who had received it from Mr. W. Robert, of the Topographical Survey of India, by whom it was captured in the Naga hills, one of the hill-ranges of North-eastern India.

EXPLANATION OF PLATE XVII. FIGS. A–C.

Fig. A. *Mycteristes microphyllus*, nat. size.
Fig. B. Upper view of the head, enlarged.
Fig. C. Outline of the extremity of the clypeus, viewed from below; drawn to scale under a Ross's 3-inch.

BIBLIOGRAPHICAL NOTICE.

Manual of the New-Zealand Coleoptera. By Capt. THOMAS BROUN. Published by command. Wellington: James Hughes. 1880.

A STOUT volume of 640 pages on the beetles of New Zealand, published at the expense of the local government, marks an era in the scientific history of the colonies. If we except Ceylon, no other British possession has shown itself so far above "the miserable theory of money on the ledger being the primary rule for empires, or for any higher entity than city-owls and their mice-catching."

Capt. Broun has laboured under immense difficulties. With few books and no opportunity of comparing his "new species," he has given very fair descriptions (beyond, indeed, the European average) of such as he believes to be undescribed. The author, moreover, living in the island of Kawau, had not even an opportunity of revising the proof-sheets of his work, although this has been ably done for him; and, as might be expected, he has not been able to satisfy himself as to the generic location of many of his species, nor has he always been fortunate in the names he has applied to them. We are sorry Dr. Hector, who appears to have seen the work through the press, did not suggest to Capt. Broun to change them.

The plan of the writer has been to give the original descriptions of various authors; and these are generally supplemented by remarks of his own; but, as he has omitted the usual quotation commas, it requires some care to distinguish between them.

From the list given at the beginning we find that 1141 species are described. To those who have been in New Zealand, and noted the apparent scarcity of animal life (mosquitoes excepted), this must appear to be a very large number. Many, however, are only known at present from one or, at most, two or three specimens; and some will perhaps be found to be merely varieties. As usual in island faunas, Curculionidæ are the most numerous; they number 207 species; then follow Longicorns 182, and Carabidæ with 135. Buprestidæ have only 2 species, Scarabæidæ 29; and all the Phytophagous families do not yield more than 36: these three groups are in marked contrast with the numerous species of the Australian fauna. The comparatively small families of Pselaphidæ and Colydiidæ are represented by 44 and 49 respectively.

There is very little in its beetle-fauna to connect New Zealand with Australia, and still less with any neighbouring land. Prof. Huxley considers these islands to form a distinct zoological province: they are certainly peculiar in the fragmentary character of their productions; but they have no endemic groups larger than genera, and few of these are very remarkable. Captain Broun's list contains 355 genera: of these, 93 are represented in England, while the otherwise exclusively Australian genera are nearly confined to *Leperina*, *Adelium*, *Amarygmus*, *Tanychilus*, *Rhadinosomus*, *Pachyura*, and *Euthyrhinus*. With regard to the other orders of insects it is perhaps hazardous to say that they are not represented in such large numbers; still there is reason to believe that the Coleoptera exceed all the rest together. It is to be hoped that this useful work will be followed by others completing the insect-fauna.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

February 4, 1881.—Thomas Boycott, M.D., F.L.S., Vice-President, in the Chair.

"On the Origin of Colonial Organisms." By Dr. ANDREW WILSON, F.R.S.E. &c.

EVERY animal develops, directly or indirectly, from an "ovum" or egg; and the plant springs, directly or indirectly, from the germ or seed. One chief difference between low and high forms of life consists in the fact that the development of the former ceases at a stage when the development of the latter has barely begun. The *Gregarina* is a microscopic speck of protoplasm living parasitically within the bodies of earthworms and other Articulated animals. When development takes place the body becomes oval, develops a wall or cyst, and the internal protoplasm breaks up into small spindle-shaped masses. The body then ruptures, and the small segments escape, each to become a Gregarina, without further change, save the development of a nucleus. Each Gregarina at first appears as a single animal or *persona*, which converts itself by segmentation into an aggregation of such beings. There is thus a temporary development of a compound or colonial state. Similarly the *Amœbæ* (which are low Protozoa, living in stagnant water and infusions, and moving, as do the white corpuscles of our blood, by emitting *pseudopodia*, or processes of their protoplasmic substance), when undergoing development, exhibit segmentation or internal division of their substance, and thus exhibit a compound state as a transitory feature of their reproductive phases.

It is noteworthy that in developing from the eggs the embryos of all higher animals exhibit a like process of segmentation or division, as a preliminary phase of their reproduction. There are also forms of Protozoa (*Myxodictyum*) which are truly "colonial" as adults, and which consist of masses of protoplasm aggregated together to form compound organisms. The Foraminifera are likewise "colonial:" since the shells of these minute Protozoa exhibit, as a rule, a division into chambers, each occupied by a distinct protoplasmic unit, organically connected to its neighbours, from which it was produced by budding.

The *Volvox globator*, formerly known as the "Globe animalcule," but now ascertained to be a free-swimming lower plant, is composed of distinct units, each provided with two cilia, and resembling a *Chlamydomonas*. *Volvox* is, in fact, a colony of monads. A Sponge is a compound or "colonial" organism, in that it consists of an aggregation of protoplasmic units, some of which resemble *Amœbæ* in nature, whilst others resemble Chlamydomonads. The protoplasmic units of a sponge-colony are, as a rule, united together by a common skeleton they have helped to elaborate. Each sponge grows from an egg, the process of reproduction by "budding" being also represented in the group. Two *Spongillæ*, or common freshwater sponges, will unite if placed in contact, or may separate spontaneously. The sponge arising from an egg, like a higher animal, thus exhibits segmentation and segregation of its parts and comes to retain this segregate and colonial nature as a permanent feature of the race.

The *Hydræ* of the freshwater pools, lead us to a type of animals nearly related to the sponges. Each is a tubular animal which may be artificially divided, and which throws off *gemmæ* or buds naturally. Each *Hydra*-bud grows into the exact likeness of its parent, and ultimately detaches itself from the parent body.

The zoophytes are simply *Hydræ* which have budded, but whose buds remain permanent to form a veritable tree, whose growth is ever increasing, and through whose branches a continual store of nutriment is continually circulating. Many zoophytes produce eggs which simply and directly develop into the compound adults by budding. Others develop eggs through the media of jelly-fish or medusoid buds, which break away from the parent tree and live an independent existence in the sea. In some zoophytes there may be seven different kinds of units in the colony, all referable, however, to one type.

A *Flustra*, or "sea-mat," grows upon shells, and resembles a piece of pale brown seaweed. Each organism is an animal colony; but its units, which may number several thousands in one organism, are not structurally connected together like those of the zoophytes, but are contained each in a separate cell.

The *Tæniada*, or tapeworms, consist each of a linear series of similar "joints." Each "joint" is in reality comparable to the unit of zoophyte or "sea-mat;" for it is essentially a distinct member of a colony, and possesses a complete set of generative and other organs, and is produced from the head and neck by budding. According to Hackel, starfishes and sea-urchins are each compound or "colonial" animals. Structurally, it is provable that each ray of a starfish corresponds with worm-structure in broad details. The *Naïs* and other freshwater worms produce young forms by a new head being budded out amongst their joints. There is here seen a tendency to become doubly "colonial;" inasmuch as the single worm is typically a "colonial" animal, and the new head-development causes this compound body to detach a new colony.

Amongst insects, the *Aphides*, or plant-lice, produce by veritable "budding" new generations, and the queen-bee does not fertilize those eggs which are destined to become "drone" bees. Thus the homology of an egg with a "bud" appears demonstrable.

It is the business of philosophy to correlate and arrange facts to form a harmonious and scientific system. The philosophy of biology leads us firstly to define an "individual" structurally as a being whose parts and organs are so closely and intimately connected, that separation of even a limited structural area means disintegration of the individual as a whole. Physiologically, an "individual" animal or plant is the *total* development of a *single* egg or seed. As the whole zoophyte, sea-mat, and tapeworm arise each from a single egg, each, *in toto*, is an "individual." The separate units of each are named "zooids." A new personality does not enter into the life-cycle of any animal or plant until a new egg or seed has been produced. Even in the case of the *Hydra*, although the buds become detached and, to all appearance, are each as truly an "individual" as their parent, they possess nevertheless no true personality. They are merely units or *zooids* of a colony; they were produced by budding, and as such are not "individuals" but parts of an "individual." If we assumed that the buds of a zoophyte or tapeworm were "individuals," we might with equal correctness speak of the joints of a lobster or worm as "individuals" likewise. Even in human structure itself there are to be seen traces of a fundamentally "colonial" nature. The tissues of the highest animals are but aggregations of cells. As such, they have a semi-independent constitution; and there are certain protoplasmic cells (*e. g.* the white or amœboid corpuscules of the blood) which roam independently at will through the body, and possess powers of movement exactly resembling those of the *Amœba* and its kind.

A progressive tendency, according to the theory of evolution, marks the organic series. The conversion of the "colony" into the "individual" (in other words, the concentration of originally separate and independent "units" or "zooids") is the chief developmental cause of the differences between high and low organisms. The primitive condition of all organisms is the "colonial" condition. Egg-segmentation (or, in Protozoa, body-division) is universal in the animal world; and cell-multiplication begins the development of plant-life likewise. Arrest of development, at an early stage distributes the separate units thus formed (as in *Gregarina*); arrest at a later stage gives us the sponge colony (a series of similar aggregated cells), or the tapeworm colony (a collection of essentially similar "joints"). Physiologically, the higher organism devotes less time to pure reproduction and becomes more explicitly busied with individual interests. Hence the increased concentration of energy which results in the formation of the highest "individuals," that yet retain, in the "colonial" and cellular structure of their tissues, the evidence of an originally compound nature.

In the plant world, such "individualization" is seen as a secondary tendency in the close aggregation of flowers in Compositæ, and in the transformation of uniform composites (*e. g.* thistle) into individualized forms (*e. g.* daisy) through such intermediate steps as the centauries.

The conclusions of our study of "colonial" organisms are as follows:—1. The original condition of organisms is colonial: the universal segmentation of the egg is a proof of this inference; and the development of new forms by this so-called process in low forms like Gregarinæ &c. supports this conclusion. 2. The lower we proceed in the scale of being, the more marked is the tendency to form "colonial" organisms. 3. Arrest [illegible] development, by causing an organism to cease progressing a[illegible] segregated stage, will tend to produce a "compound" and "co[illegible]" constitution. 4. The plant world is "colonial" in its high[illegible]pes. Plant-development has not proceeded towards any mark[illegible]rease of "individuality" over the colonial nature of lower forms. A tree is in many respects as markedly "colonial" as a *Volvox*. 5. The highest animals exhibit lingering traces of an originally "colonial" nature in their histological composition. 6. The tendency of life-development is towards concentration, and the conversion of the "colony" into the true "individual."

It is suggested by way of final inference, and by way of incursion into a biological by-path, that the theory and idea of an originally "colonial" constitution may explain the existence in man and higher animals generally of those tribal and family associations which mark the upper strata of existence. The semi-independent action of many parts of the higher brain, for instance, receives an explanatory hint, as to causation, from the idea of an originally independent and colonial constitution.

DUBLIN MICROSCOPICAL CLUB.

June 24, 1880.

Two probably distinct forms of Penicillium.—Mr. Pim showed two forms of *Penicillium* perhaps specifically distinct, one with the chain of spores repeatedly branched, the other presenting only four or five quite simple chains. They were the extreme forms, on either side, of which *P. glaucum* may be looked upon as the mean. The compound form occurred on a decaying Agaric, and the simple one on dead flowers of *Euphorbia jacquiniæflora*.

Trichodectes subrostratus.—This louse from a cat was shown by Dr. W. M. A. Wright. Two of the specimens of this species (which had not hitherto been found in Ireland) corresponded with the description given by Denny; the third had a bituberculate apex to its rostrum, and so answered more closely to the species described by Burmeister.

Two rotund, granulate Staurastra, one referred to St. turgescens, De Notaris, *and another (probably undescribed) superficially resembling but essentially distinct, and with distinct zygospores.*— Mr. Archer exhibited the zygospore of a *Staurastrum* which, as regards the parent form itself, seems to come very near that which he for the present identifies as *St. turgescens,* De Notaris; and to a casual observation indeed they might seem identical. The form attributed to De Notaris is more plump and rounded—seemingly in itself an inadequate difference on which to found a species; but yet this seemed to carry with it internal differences in the mode of arrangement of the contents. In the form of which the zygospore was shown on the present occasion the mode of arrangement of the contents in the parent form was strictly that of a typical *Staurastrum,* or that most common in the genus—that is to say, the contents forming pairs of chlorophyll plates radiating from the central axis of each semicell towards the angles. This might probably be called the medio-laminar arrangement, or, better, the elasmo-mesenteric arrangement (that by far the most common in Desmidieæ), in contradistinction to the mode prevailing in certain other species, where the chlorophyll lies in variously disposed and specifically more or less characteristic plates on the interior of the outer wall, which might be called the parieto-laminar arrangement, or, better, the elasmo-pleurenteric arrangement. Now in the form identified as *St. turgescens,* De Notaris, the mode of arrangement of the contents is different; for the chlorophyll masses, though radiating from the centre, do not form double laminæ, but irregular rays, projecting in every direction; they thus somewhat compare to the configuration of the contents in the joint of a *Zygnema.* This might be called the stellate arrangement, or, better, the astro-mesenteric arrangement, and is rare in Desmidieæ, but characteristic of the non-constricted genus *Cylindrocystis.* But, above all, the form now shown, however it may externally resemble that of De Notaris, differed *toto cœlo* in its zygospore therefrom. In that species, exhibited to the Club at a former meeting, the zygospore is as yet unique amongst Desmidieæ: in figure it more nearly approaches that of *Cosmarium margaritiferum* than any other; but it is compressed, not orbicular, and, besides, the superficial convexities are broader and not so elevated, whilst its colour is of an orange or yolk-of-egg colour, resembling, in fact, that of the spores of *Volvox*, and wholly unlike that of any other Desmid. In the *Staurastrum* now shown, however, the orbicular zygospore is beset with slender spines, slightly dilated at the base, and minutely bi- or trifid at the apex, and green in colour—in fact, belonging to a widely diffused type of zygospore. Thus these two forms, however much they may *externally* resemble each other, declare themselves essentially distinct, and that in a manner sufficiently pronounced.

October 21, 1880.

Loligo magna.—Prof. Mackintosh exhibited a cross section of the arm of the common Squid. The section showed that the axis of the arm was occupied by a large nerve, which sends branches to the pistons of the suckers; in the sheath surrounding the nerve were three bloodvessels, the coats of which were very distinct, and which could be seen in longitudinal sections to send branches into the substance of the nerve as well as to the surrounding muscular bundles which composed the greater part of the arm, and were disposed in various ways. The number of vessels varied from two to five. Mr. Mackintosh had used both Rutherford's carmine and Ranvier's picrocarmine as staining-fluids; but the former gave the best results.

A new form of Potato-disease.—Mr. Greenwood Pim exhibited specimens which had been given to him by Mr. Balfe, of the Royal Horticutural Society, who had received them from Galway, where the disease had materially injured the crop. On splitting the stems a number of small roundish bodies about the size of small peas were found imbedded in downy mycelium. These, when young, are white, but turn black as they get older. A section through one of them shows it to consist of a sclerotioid tissue of condensed mycelium, somewhat like Ergot, but differing from it considerably. Under present circumstances, and till some form of fructification is produced, it is not possible to say to what group of Fungi it is to be referred, as the old genus, to which it would formerly have been relegated (*Sclerotium*), has been abolished, it having been shown to consist of conditions of various very distinct Fungi. Mr. W. G. Smith, who has examined specimens, coincides in this view.

Section through Sebaceous Gland of Skin of Negro.—Mr. P. S. Abraham showed a section through the sebaceous gland of the skin of a negro. The gland was in the neighbourhood of a tubercle of leprosy; and it was uncertain how far its great size or hypertrophy was due to this pathological condition. The cells of the gland were of uncommon size, and showed most clearly the reticular protoplasm of the nucleus, as well as of the cell-substance; and it was, indeed, chiefly in illustration of this that the slide was exhibited. Mr. Abraham had with him some sections through the tail of a newt, in which the epidermic cells showed the same structures, corroborating the observations of Klein, Fleming, and others, upon which he made some remarks.

Structure of an abnormal pilose Tumour in the Pharynx.—Mr. Abraham further showed a section through an abnormal pilose growth, congenital, in the pharynx of a girl. A white glistening tumour had been for years observed in the girl's throat behind the volum palati. Latterly it increased much in size, and interfered with swallowing. When excised and examined microscopically it was found to consist chiefly of adipose and areolar tissue, with a central nodule of fibro-cellular cartilage, with fibres of striped muscular tissue passing in various directions; it was covered with ordinary skin, possessing a well-marked epidermis with *rete Malpighii* and corneous layer, numerous hair-follicles and hairs, sebaceous and sudoriferous glands. There was in places a considerable hyperplasia of epidermic cells. Mr. Abraham threw out the suggestion that the pressure of epidermis on the top of the pharynx might indicate the line of epiblastic invagination by which we know the pituitary body is formed in the embryonic encephalon.

Green Gland of Palinurus.—Mr. Henry St. John Brooks showed sections of the green gland of *Palinurus vulgaris.* The object, so difficult to obtain, owing to its quick decomposition after death, had been secured by killing the animal by hæmorrhage, when the gland was dissected out and placed in absolute alcohol.

Metacarpal Bones of the Manus of a ten-day Puppy.—These were shown in section by Mr. B. C. Windle. The first section, taken about the middle, besides the normal muscles, tendons, &c., showed an extra interosseus muscle between the second and third metacarpal bones, which was interesting as pointing to a probable original symmetry of the interossei, subsequently lost by the disappearance of one. The second section, taken from the same puppy at the base of the first phalanges, showed the bosses of cartilage which would have developed into the desmoid bones.

Botryosporium diffusum, Corda.—Mr. G. Pim showed *Botryosporium diffusum,* Corda. This is one of the most beautiful and delicate forms amongst the Mucedines, and consists of numerous slender threads branching occasionally and beset with short ramuli, each crowned with a globose mass of minute oval spores. The whole plant is pure white. The specimens shown occurred on dead stems of *Ipomœa* at Monkstown, co. Dublin, this autumn.

Aspergillus from Membrana tympani.—Mr. B. Wills Richardson exhibited a scarlet staining of an *Aspergillus* in fructification that had been removed from the membrana tympani of a medical friend.

The fungus rapidly developed on the membrane, causing temporary deafness of the corresponding ear. The specimen, which was mounted in Farrant's solution, showed a well-marked mycelium and two fruit-bearing hyphæ, each having a sporangium in a more or less mature condition.

In D. B. St. John Roosa's treatise on diseases of the ear (p. 138) there may be seen an illustration of *Aspergillus flavescens* in fructification that more nearly resembles the specimen exhibited than any of the representations of *Aspergillus* which he had seen.

Anabæna living in Botrydium.—Dr. E. Perceval Wright exhibited a specimen (for which he was indebted to his friend Dr. E. Bornet) of *Botrydium granulatum* from Montmorency, which had been the subject of a paper by Dr. M. L. Marchand in the 'Bulletin' of the Botanical Society of France (28th November, 1879). It is now well known that many plants belonging to the group of the Nostocs without gelatinous cell-walls live within the cells of other plants: thus they are to be found in *Azolla*, *Anthoceros*, *Blasia*, *Gunnera*, and *Lemna*; and it was to be expected that they would equally find themselves at home in the cells of even more simply organized plants. The instance exhibited was of special interest; it had been detected by Dr. Marchand while examining under the microscope some plants of *Botrydium*, which, instead of containing the usual mass of granular chlorophyll, seemed filled with a chain of moniliform filaments. These were composed of cells, some oblong, with yellowish heterocysts; they did not fill the entire cavity of the cell, and seemed to adhere to its inner walls. The *Botrydium* plants were perfect; the root-like prolongations, as well as the rest of the plant, were quite closed; and it is a question still to be investigated as to how the *Anabæna* got in. Dr. Marchand calls attention to the remarkable figure of Mr. E. Parfitt ('Grevillea,' vol. i. pl. vii. p. 103), in which there can be now little doubt with the light thrown on them by Dr. Marchand's discovery, that there is represented our common *Botrydium granulatum* with an endophytic *Anabæna*, the latter shown in a crushed condition and somewhat feebly represented; but the observation of Parfitt is now seen to be not without a special interest of its own.

November 19, 1880.

Triticum monococcum.—Dr. M'Nab exhibited sections of the embryo from seeds which had been hardened in absolute alcohol, and sections cut in three directions of the naturally imbedded embryo. The structure could be readily made out and a complete demonstration obtained of the central row of large cells from which the first vessel originates. This row of cells in the wheat is apparently quite the same as that figured by Kny in his 'Botanische Wandtafeln' as occurring in *Secale cereale*.

Section of Epididymis of Dog.—Dr. P. S. Abraham presented a section through the epididymis of a dog hardened in a ⅛-per-cent. solution of chromic acid and stained with logwood, chiefly to show the relations which exist between a cell and its cilia. The latter were seen to be prolongations, as it were, of the protoplasmic network, which, arranged longitudinally in the columnar epithelial cell, makes up its substance. Dr. Abraham made some remarks on the movement of cilia, and referred to Dr. Klein's mechanical explanation.

Problematic Closterium-like "*Semicell,*" *its Nature, or its Place in Nature, undecided.*—Mr. Archer showed an example, about the third or fourth he had met with, of the empty "wall" of what appeared, as regards figure and aspect, to be a *Closterium* of large size and coarse build; but, seeing that he had never found any green contents, or even the remains of any green contents, and not only so, but that, previously as now, the example appeared to be only a "half-cell," and that (at the broader end or middle of the supposed *Closterium*-cell) as it were rudely torn, not seemingly separated at any line of suture, possibly after all this might even not be a Desmid at all. Still its curvature and form were those of a *Closterium*—the wall thick and red, the ends bluntly rounded (not unlike the contour of *Closterium Ehrenbergii*), the "lower" margin curved a little upwards towards the apex, and the superficies were ornamented by slightly irregular lines of erect gland-like papillæ, which, viewed at the edge, imparted to it a fringe-like aspect; sometimes a series of these papillæ became for a little space interrupted, and sometimes stopped short ere reaching the gradually narrowing extremity, as it were to avoid overcrowding at the apex; the intervals between the lines of papillæ smooth.

Thus this form resembled a good deal that named by Reinsch *Closterium Braunii*, which, however, it assuredly was not. That form is no doubt a true and remarkable *Closterium*, whereas, as seen, the present form remained not a little of a puzzle. In *Closterium Braunii* the verrucula composing the longitudinal lines are very closely posed, so much as at first sight to appear as ordinary striæ, which they are not; whereas in the present form the elongate verrucula show very appreciable and somewhat irregular intervals as they run in slightly irregular file. Can this object belong to any animal or animal's limb? The determination of the puzzling object now shown, one way or the other, would be a matter of interest.

An Ancient Sea-weed.—Dr. E. Perceval Wright exhibited sections of a small morsel of marble from the "Calcaire Carbonifère, terrain primaire," of Namur, in Belgium, under a ¼-inch objective, which clearly showed the cell-system of an Alga. This most ancient seaweed had been described by M. Munier-Chalmas in 1876 as *Lithothamnion marmoreum*. The wonderful state of preservation of this fossil plant enabled almost the minutest details of cell-structure to be seen.

December 16, 1880.

Cross Section of Leech.—Prof. Mackintosh exhibited a cross section of the body of the medicinal leech, and called attention to the system of anastomosing tubes of different sizes to be seen in the cells of the nephridium. These were very well described by Bourne, in the July number of the 'Quarterly Journal of Microscopical Science' for the current year. Prof. Mackintosh's results, which were obtained independently, agree in the main with Bourne's. He was not quite sure, however, that the latter was correct in his supposition (offered with reserve) that there was no communication between the duct of the nephridium and the tubules; but on this point he would not speak with certainty until he had studied the rest of his sections.

Olpidium Griffithsiæ, n. s., Perceval Wright.—Prof. E. Perceval Wright exhibited a number of mountings showing the various stages in the life-history of a new species of *Olpidium* to be called *Olpidium Griffithsiæ*, found by him in the as yet unopened fructification of *Griffithsia setacea.* Led astray by appearances, even though on his guard at the time, Dr. Wright had once, some time ago, showed these as antheridia: but the antheridia of *Griffithsia* have been shown by Thuret to be of the ordinary type; and an investigation of these growths for a few days this September, at Dinard, revealed their true nature, the first hint of which had been given to him by Dr. Bornet. Specimens were met with of a fine green, as well as of a pink, colour; and full details were promised.

Human Spinal Cord.—Mr. P. S. Abraham showed a section of human spinal cord taken from the cervical region, near to the medulla oblongata. The point of interest in the specimen was that in two instances the processes of the large cells of the anterior cornua of the grey matter seemed to anastomose with processes from other cells, an arrangement not generally figured in histological works.—Mr. E. G. Hull likewise showed sections of spinal cord.

Sections of the Killiney Granite, showing minute Crystals of Apatite, shown by Prof. Hull.—These appear as long, slender, colourless prisms traversing the quartz of the granite; and in cross section apparently show a polygonal form; but being exceedingly minute, it was difficult to determine whether or not they were hexagonal. They were visible with a one-fourth objective and No. 1 eyepiece, but with a one-fifth objective were very well defined. Prof. Hartley, F.C.S., had previously tested the specimens from which the slides were made for phosphate of lime, and found it present in very minute quantities in the silica, corresponding to the smallness of the prisms shown in the slides.—Dr. Frazer stated that he had obtained a crystal of apatite from the granite of Killiney, but that their occurrence is very rare.

New Algal Form appertaining to Stigonema.—Mr. Archer showed a form appertaining to the genus *Stigonema*, which seemed worthy to stand as a distinct species. This form grew free in water (not attached like other species), and formed short stout filaments, mostly rather regularly cylindrical, but occasionally, though rarely, presenting enlargements along their length, lending a torulose aspect. Unlike *Stigonema mamillosum*, this had not lateral branches for the giving off of propagative cells; but in place of these almost every example was furnished, mostly at each end, sometimes at one only, with a prolongation, often of considerable length, similar to (but usually much longer than) the lateral branches of *S. mamillosum*. These prolongations could be seen filled with larger-sized "cells" than those of the main filament and in single file; but mostly these tubular prolongations were already emptied. Thus the present examples looked not unlike, as it were, a *Stigonema* in the middle, becoming suddenly transformed at either end into a *Sirosiphon*—an interpretation, however, which could hardly be entertained as the correct one; these ought rather to be regarded as analogous to the branches of *S. mamillosum*, lateral in that species, here terminal. Consequently the distinction into a basal and apical extremity must be regarded in this form as obliterated, being, so to speak, a form with *two* apices and *no* basal extremity. A branching seemed rarely to take place. One example, indeed, presented two short branches, each terminating in one of the described *Sirosiphon*-like continuations; the empty terminal prolongations thus appeared as tubular hyaline "tail-like" appendages. The internal structure of the "stem" did not appear like that of *S. mamillosum* or *S. atrovirens* (=*Ephebe pubescens*), the "cells" being smaller and more lenticular; but it especially differed in the very regularly posed, nearly equidistant, centrally located and *lenticularly* shaped (not orbicular) heterocysts. This form might possibly stand as *Stigonema amphiacrogenum*.

MISCELLANEOUS.

On the Organs of Taste in the Osseous Fishes. By M. E. Jourdan.

F. E. Schulze, in two memoirs published in 1862 and 1867, described the cyathiform bodies of the barbel and of the tadpole of *Pelobates fuscus*, and found in them a structure analogous to that of the corpuscles described by Lovén and Schwalbe in the tongue of the Mammalia. He was thus led to assign to the cyathiform corpuscles of fishes functions identical with those of the gustatory bodies of the mammalian tongue.

Our researches upon several fishes, and especially upon the *Peristedion cataphractum*, or Malarmat, have enabled us to observe some new facts, which confirm F. E. Schulze's opinion.

The Malarmat presents the remarkable peculiarity of possessing at the same time barbels like those of *Mullus barbatus*, and free rays identical with those of the Gurnards. The thick cuirass which covers the body of these fishes seems to justify the development of these organs of taste and touch and their grouping in different regions. The barbels of the Malarmat, which are sometimes arranged in tufts, sometimes isolated, fringe the lower jaw to the number of ten or twelve; two of them always attain very large dimensions, and present secondary ramifications. All these barbels are furnished with cyathiform bodies of no great size and formed by the union of two sorts of cells: some of these, grouped in the centre and projecting slightly at the surface of the barbel, are like fibres furnished with a voluminous nucleus; the others, arranged at the periphery, are cylindrical and terminate in a flat surface. These little organs not only exist on the barbels, but they are also diffused in great numbers in the mucous membrane that lines the buccal cavity; they are arranged in rows in the pharynx; and three or four of them occupy each of the little papillæ which project from the rudimentary tongue. They are always seated in the epidermis; but their structure is difficult to make out, on account of their small dimensions.

The cyathiform bodies of *Mullus barbatus* are much more voluminous; hence we have been able to make a more complete investigation of them. They are like those described by F. E. Schulze in the Barbel and the Tench. Each corpuscle is situated in a point of the epidermis corresponding to a papilla of the dermis; it is clearly marked off from the cells which surround it by the dark coloration which it acquires after the action of osmic acid and by the aspect of its constituent elements. Each of them is formed of cells belonging to two types, between which we observe all transitional forms: some are cylindrical and situated at the periphery; the others, grouped at the centre of the ovoid body, terminate in a conical prolongation, the points of which, generally masked by mucus, appear less distinctly than in the Malarmat. All these elements are furnished with a voluminous nucleus; and their protoplasm is strongly coloured by osmium. At the base of each corpuscle we see a small granular mass, formed by the varicose basal prolongations of the cells of the cyathiform bodies: it is in this granular mass that the cylinder-axes of the nervous fibres disappear; and from it the cells of the corpuscles emerge. *Mullus barbatus* possesses ovoid bodies, identical with those which we have just described, in the mucous membrane of the tongue and pharynx.

In the Gurnards we have found cyathiform corpuscles upon the tongue. It is probable that they exist in the buccal mucous membrane of most fishes.

From the facts just indicated we must conclude that, among the nervous terminations in fishes described by M. Joubert as *organs of touch*, we must distinguish those which possess cyathiform bodies from those which are destitute of them. What functions are we to attribute to them? From the investigations of F. E. Schulze, F.

Todaro, Engelmann, Lovén, and Schwalbe it seems to us difficult not to regard the cyathiform bodies of fishes as gustatory papillæ. Their structure and their situation in the epidermis separate them completely from the tactile corpuscles, such as we commonly see in birds and mammals.

The sense of taste thus acquires in fishes an importance which may appear exaggerated, but which seems to us accounted for by the nature of the medium in which those animals live. The search for food in these creatures must be guided especially by sensitive terminations more particularly destined to the reception of gustatory emanations; and this explains the distribution of the cyathiform bodies upon external organs, explorating-apparatus, the situation of which has deceived observers, but which need no more surprise us than the existence of well-formed otocysts, far from the head, upon the last segments of the *Mysides*.—*Comptes Rendus*, March 21, 1881, p. 743.

On the Pteroclidæ. By Modest Bogdanow.

From anatomical data Elliot ("Study of the Pteroclidæ, or Family of the Sand-Grouse") arrived at the conclusion that the Pteroclidæ should be placed between the Columbæ and the Rasores, a position which had been indicated for them even before Elliot's work, and as to the correctness of which the author thinks there can be no doubt. He regards it, however, as a more rational course not to refer the Sand-Grouse either to the Columbæ or to the Rasores, but to raise them into a distinct order, as many peculiarities of organization, as well as the mode of life, separate them sharply from the Rasores. Thus the form of the wings and feet is by no means gallinaceous; the coloration and the mode of life are quite peculiar; further the eggs resemble those of the pigeons, but possess a special coloration, and the layings of the Pteroclidæ consist normally of only three eggs, whilst in the Gallinæ they are much more numerous. Finally, in the Pteroclidæ the young after exclusion are covered with a down of very peculiar coloration, and are not blind, although they are unable to run about. All these characters, with many others, induce the author to propose to raise the Pteroclidæ to the rank of an order, standing between the Columbæ and Rasores, and for which he suggests the name HETEROCLITÆ.

Besides the Pteroclidæ the Thinocoridæ must be referred to this order in accordance with the views of C. L. Bonaparte. The agreement between *Attagis* and *Pterocles* is so striking that one cannot understand how the Thinocoridæ have been referred to the Grallatores. The two genera just mentioned not only resemble each other in external characters, in the form of the beak, wings, and feet, in the plumage, &c., but even in the character of their dwelling-places they offer a very remarkable agreement. The species of *Pterocles* inhabit deserts and are always companions of the camel; the species of *Attagis* live on the alpine meadows of the Andes and are associated with the llamas.

Finally the author describes two new species of *Pterocles*, namely:—*P. Severzowi* (=*Tetrao caudacutus*, Gmel.,=*T. alchata*, Gmel.,=*T. chata*, Pall.,=*Pterocles caspius*, Ménétr.) from the Aralo-Caspian steppes, Turkestan, Transcaucasia, and North Persia; and *P. Ellioti* from Abyssinia.—*Bull. Acad. Imp. Sci. St. Pétersb.* tome xxvii. pp. 164–168.

Investigation of certain Points in the Anatomy of Sternaspis scutata.

By M. Max. Rietsch*.

The *Sternaspis* measures about 0·030 metre in length and 0·010 metre in breadth. Its body, which is attenuated anteriorly in a state of repose, is inflated in front and behind and constricted in the middle when the animal, in order to move, throws forward the retractile anterior portion of its body. The latter bears three rows of setæ, which are interrupted upon the dorsal and ventral lines, and which may be concealed by the invagination of the anterior region of the trunk. The mouth, which is somewhat ventral, is surmounted in front by a small prominence homologous with the cephalic lobe, and indicating the place occupied by the cerebroid ganglia. In the posterior region we observe a ventral shield fringed with tufts of setæ, except at its anterior margin; above its posterior margin is placed the somewhat dorsal anus, which is surmounted by two oval perforated plates garnished with numerous branchial filaments. Towards the anterior third, upon the ventral surface, we may distinguish two small conical appendages, axially perforated; these are the external terminations of the generative organs. There are also small bundles of setæ in the median ventral region of the body; but they do not appear beyond this.

The integuments consist of a thick and resistant fibrous layer, striated parallel to the surface, covered externally by a layer of hairs, which alone seem to represent the epidermis, and lined internally with a granular stratum, in which we may sometimes succeed in detecting nuclei: from this layer, which internally is in contact with the muscles, a number of more or less undulated filaments start, traversing the fibrous zone perpendicularly and terminating in the hairs; chloride of gold, employed as suggested by M. Ranvier, gives them an intense violet colour, as also to the granular layer, while the fibrous zone remains nearly colourless. I think we may regard these filaments as nervous terminations.

Further in we meet with an external layer of transverse muscular fibres, then an inner layer of longitudinal fibres, which are inserted upon the reentering lines bounding the segments. I shall confine myself here to indicating further the powerful development of the retractor muscles, formed principally of two bundles placed on the sides of the nervous cord, and the fibres of which are implanted in front at the base of the anterior setæ, and behind upon the ventral surface of the integuments: these fibres are of unequal lengths; some of them reach the ventral shield. These muscles cause the invagination of the anterior part of the trunk, the protraction of which is brought about by the posterior transverse muscles, which, by contracting, drive forward the fluid of the general cavity.

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* The author's examinations of this worm were made on specimens from off Cape Breton, in the Bay of Biscay, and from the Gulf of Lyons.

The digestive canal at first travels from before backwards, bends round near the perforated plates, returns forward, then turns again backward to terminate at the anus: it forms numerous convolutions, and is further irregularly twisted spirally with the generative organs. We may distinguish in it the following regions:—1, a wide, short, protractile pharynx, in the form of a bulb, presenting glandular ridges; 2, a much narrower and longer œsophagus, which is analogous in structure to the stomach, but is destitute of the vibratile furrow, and its less developed epithelial layers possess no granulations; 3, a stomach considerably wider than the other parts of the intestine, and composed of the peritoneum, of a feeble muscular layer, the scattered fibres of which are partly longitudinal, partly transverse, and of a greatly developed glandular epithelium which forms prominent longitudinal ridges in the interior; at the commencement of the stomach originates a vibratile furrow, which only stops at the terminal part of the intestine; the stomach secretes a yellowish liquid which gives a green colour with Gmelin's and a red colour with Pettenkofer's reagent; I think it may be regarded as bile; 4, a recurrent intestine, and, 5, a posterior intestine, which I distinguish from each other principally because of their general direction, and to facilitate a more detailed description; their structure essentially resembles that of the stomach, except the smaller development of the epithelium, which is here no longer glandular; 6, a protractile terminal intestine, destitute of the furrow and presenting the structure of the external skin.

The nervous system consists of two cerebroid ganglia, of a wide collar embracing the pharynx, and of a ventral cord, which widens considerably behind over the shield, in consequence of a greater development of its connective elements. On its ventral surface this cord gives off numerous unpaired nerves, directed downwards and backwards, which afterwards bifurcate into two symmetrical branches. I have not yet completely elucidated the question of the relation of these branches with the granular layer and the nervous filaments mentioned above.

The branchial filaments, destitute of cilia, have their internal cavity divided longitudinally by a fibro-muscular partition; the two elongated sinuses thus formed communicate by a loop at the free extremity of the filament, and unite to form a single canal near the point of insertion upon the perforated plate. In the living animal we see some of these filaments elongated in the water, which they beat; the red blood contained in them enables the loop formed by the two sinuses to be recognised; but most of the filaments are usually retracted and spirally rolled up by the contraction of the longitudinal muscles which line the two sinuses, and which drive back the blood to the interior of the body, whilst the elongation of the branchiæ makes it flow into them. At the point of insertion of each filament the perforated plate is traversed by a short canal lined with an epithelial layer, and afterwards dividing into several branchial vessels. Between the filaments the plates, the structure of which is analogous to that of the skin, have numerous hairs. The branchial vessels of the two plates all open into a wide and very short canal, which opens into the dorsal vessel.

In a future communication I will summarize my observations on the vascular and generative systems, the segmental organs, and the embryogeny of this worm.—*Comptes Rendus*, April 11, 1881, p. 926.

The Bears of the Cavern of Lherm. By M. H. Filhol.

As is well known, the bone-cave of Lherm, in the Ariège, has furnished numerous remains of animals, including *Ursus spelæus*, *Felis spelæa*, *Hyæna spelæa*, *Rhinoceros*, *Cervus*, &c. The most frequent of these is the first-named species, *Ursus spelæus*, of which not less than one hundred crania have been obtained. M. Filhol remarks that these numerous crania prove the great fixity of character of this species, and that *Ursus spelæus* in its most modified forms has nothing to do with the existing *Ursus arctos*. M. Marty has recently found two skulls of bears different from any previously met with. One of these, a perfect skull, measuring along its lower surface 35 centim. from the incisive margin to the occipital foramen, has six teeth behind the canine, as in existing Bears, instead of three as in *Ursus spelæus*, and the form and proportions of those organs are as in *Ursus arctos*. This applies to the other characters of the skull; and M. Filhol identifies the animal with the living Brown Bear, which, he considers, cannot have descended from *Ursus spelæus*, but must have originated in some distant region, perhaps North America, and gradually advanced to take the place of the great Cave-Bear in these countries.

The second specimen consists of the anterior parts of a bear's head, also differing from those hitherto found in caves. In the upper jaw it had four teeth behind the canine, and the first premolar was preceded by a free space of 15 millim. Consequently the face was very short, but at the same time it was remarkably widened. Its transverse diameter behind the carnassial tooth is 10·3 centim. The anterior nasal aperture measures 64 millim. across and 51 millim. from front to back. In all other bears the antero-posterior diameter is the larger. The forehead was depressed and almost horizontally continuous with the nasal bones. Its elevation above the palatine arch at a point answering to the postorbital apophyses is only 10·8 centim.; in the *Ursus arctos* above mentioned this measurement gives 11·8 centim., and in *Ursus spelæus* 18·3 centim. The width of the forehead between the apices of the postorbital apophyses is 13·9 centim., or only a few millimetres less than in the largest crania of *Ursus spelæus*. These characters lead M. Filhol to regard this skull as representing a new species of bear; and he proposes to name it *Ursus Gaudryi*.

M. Marty has also found in the cavern of Lherm the femur of a fossil lion 46 centim. long.—*Comptes Rendus*, April 11, 1881, p. 929.

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[FIFTH SERIES.]

No. 42. JUNE 1881.

XLIII.—*On* Palæospinax priscus, *Egerton*. By JAMES W. DAVIS, F.G.S. &c.

[Plate XX.]

I HAVE recently had the good fortune to become possessed of an example of this rare fish, which serves to elucidate some characters not shown on the specimens described by Sir P. Egerton in the xiii. decade of the Memoirs of the Geological Survey (1872). Whilst proving the correctness of the deductions drawn by the author, this specimen also exhibits characters which enable me to correct some inferences drawn from imperfect evidence.

My specimen is 10 inches in length. The front part of the head is absent; and probably 2 inches of the caudal extremity is also broken away. The body of the fish included between these parts is extremely well represented. The fish is laid on its ventral surface, and exposes the dorsal. There are two large pectoral fins, two dorsal fins, each having attached to its anterior portion a bony fin-ray. There is also exposed one ventral fin, the opposite one being hidden beneath the body of the fish. The caudal fin is entirely absent. The vertebræ extend from their connexion with the head to the opposite extremity of the specimen. The whole surface is covered with minute dermal ossicles or shagreen.

There are seventy-eight vertebræ present. The second dorsal spine is evidently in its natural position with regard to the vertebræ, and is fixed above the fifty-sixth from the head; behind there are twenty-two others. The position of the anterior dorsal spine and fin has been somewhat deranged during the decay of the fish: the spine has been pressed away from the fin, and is now separated by an inch and a half, or the length of ten or twelve vertebræ. Its exact position might be difficult to determine; but a comparison with the recent dog-fish (*Acanthias vulgaris*) renders its place tolerably certain. In the dog-fish, as pointed out by Sir P. Egerton, there are one hundred and eight vertebræ. Between the head and the first dorsal spine there are twenty-five vertebræ; from the first to the second are included thirty-four; and beyond the posterior dorsal spine there are forty-nine vertebræ to the extremity of the tail. The *Palæospinax* from the Lias exhibits a remarkable similarity to the recent fish. In the latter there are fifty-nine vertebræ between the head and the posterior dorsal spine, whilst in *Palæospinax* there are fifty-six; and from this close relationship it may be inferred with safety that the anterior dorsal spine was situated above the twenty-third or twenty-fourth vertebra. It may be further urged that as there are behind the posterior dorsal spine, in the recent fish, forty-nine vertebræ, there were about the same number in the fossil one: twenty-two are preserved; and a further complement of about six or eight and twenty would complete the caudal portion of the fish. Relative appearances warrant this supposition. The total length of the fish, including the portion of the snout not preserved, would be 13 inches—a considerably smaller example than those described by Sir P. Egerton.

The head is represented by the impression of some bones or cartilages not sufficiently well preserved for identification. There are two or three teeth similar in form to the figure no. 5, plate vii. of the decade referred to previously, which indicate the proximity of the jaws.

The spines were deeply implanted in the flesh of the fish, and appear to have had a groove along the back for the reception of the fin, though this is only partially evident in my specimen. The anterior spine was smooth, its upper part thickly coated with enamel; the middle portion of the spine, not actually imbedded in the flesh, was enveloped by the dermal covering of the fish, which was thickly coated with shagreen. The posterior spine exhibits the same characters, except that it was finely, but distinctly, covered with longitudinal striations. The small tubercles mentioned by Sir P. Egerton as besetting the lower portion of the posterior spine do not appear to be present on my specimen; but the covering of shagreen presents a similar appearance to the one described in the decades. The spine attached to the anterior dorsal is 1·1 inch in length and ·2 inch wide at the base; it is slightly curved backwards, gradually contracts in size, and ends in a fine point. The second spine is similar in form but larger; it is 1·3 inch in length.

The pectoral fins are very large in proportion to the other parts of the fish; the anterior margin is at least 2·5 inches in length. They are thickly covered with shagreen, the tubercles clustering thickly and of large size along the anterior margin, and becoming more thinly distributed and of gradually decreasing size towards the posterior portion of the fin.

The ventral fins are also covered with tubercles in the same manner; they are 1·1 inch in length.

The dermal tubercles forming the shagreen are composed of little plates, highly enamelled, for the most part rhomboidal in form, in rare instances arranged like flat cubes in a tessellated pavement, but more generally with the corner towards the tail raised, as though the little cube were suspended diagonally at two of the corners transversely to the longitudinal axis of the body, and the anterior corner depressed, causing the one towards the caudal portion of the fish to be raised. The raised portion appears to be somewhat produced in some of the tubercles; but in no instance can I find evidence that any thing approaching a sharp tooth-like structure occurred in any of the tubercles, such as may be seen in many of the recent Placoids.

The figures (Pl. XX. figs. 2, 3, 4) show the relative size of the tubercles in different parts of the fish and also indicate a slightly different form. The minuteness of these objects may be inferred from the fact that there are between 30,000 and 40,000 to cover one square inch of the body of the fish.

The fossil *Palæospinax* presents an instance of a Lias fish which bears so close a resemblance in general character, and even to a large extent in minute detail, to the living *Acanthias*, that we are almost justified in considering the latter as a descendant of the former. The fossil form was a shorter and proportionally a thicker fish than the living one. Its pectoral fins were much larger and better developed. The vertebral column in the two fishes offers a very close parallel. In my specimen there are only twenty-two vertebræ preserved behind the posterior dorsal spine; but Sir P. Egerton mentions a specimen, in the collection of the Earl of Enniskillen, consisting of eighty-five vertebræ, with a spine situated above the fortieth from the anterior end, and with consequently forty-five vertebræ beyond it; this number would probably constitute nearly the whole of the caudal extremity, and is fewer by four only than in its living representative. In the specimen figured on plate vii.-of the decade mentioned the spine extends above the fifteenth vertebra. In the one now being described the anterior dorsal spine is over the eighteenth or nineteenth vertebra; there can be no doubt, however, that its proper position must have been further back, because the fin to which it was attached is far behind the spine. From analogy it would be supposed that the spine occupied a position halfway between its present situation and that of the fin; and as this would place the spine above the twenty-second or twenty-third vertebra from the head, which is, as already indicated, the point inferred from the comparison with the recent fish, there remains little doubt that such was its actual position.

Locality. All the specimens hitherto described, including the one which is the subject of this paper, are from the Lias at Lyme Regis.

EXPLANATION OF PLATE XX.

Fig. 1. *Palæospinax priscus*, Egerton (nat. size).
Fig. 2. Dermal tubercles or shagreen on ventral fin (× 25).
Fig. 3. Ditto on ventral portion of body behind the ventral fin (× 25).
Fig. 4. Ditto on pectoral fin near the base of the anterior margin (× 25).

XLIV.—*On the originally Bilateral Character of the Renal Organ of Prosobranchia, and on the Homologies of the Yelk-sac of Cephalopoda.* By E. Ray Lankester, M.A., F.R.S., Jodrell Professor of Zoology in University College, London.

Two recent memoirs on molluscan morphology touch upon matters which have formed the subject of investigations by me, and which I have formerly discussed in the pages of this journal. I am therefore anxious to make a few remarks on the matters in question in the same place as that in which I first wrote of them.

I. Dr. J. W. Spengel, in a very interesting essay (Zeitschr. wiss. Zool. vol. xxxv.) entitled "Die Geruchsorgane und das Nervensystem der Mollusken," refers to a note by me "On some undescribed Points in the Anatomy of the Limpet (*Pa-*

tella vulgata)," published in the 'Annals' nearly fourteen years ago (vol. xx. 1867, p. 334). The organs which I there recognized as the "capito-pedal" orifices he now proposes to identify with olfactory organs. With regard to this, I have to say that I have long been aware that the "capito-pedal" pigmented bodies are not *orifices* blocked by pigmented excretion, as I at one time supposed; and I have no doubt, from the nerve-supply to this region, which was clearly figured by Prof. de Lacaze-Duthiers in vol. i. pl. iv. of his 'Archives de Zoologie expérimentale' (1872), and is now again figured by Dr. Spengel, that we have in the capito-pedal pigment-body a sense-organ, similar in character to the sense-organ described by Lacaze-Duthiers as existing in aquatic Pulmonate Gasteropoda (also in vol. i. of his Archives, "Du système nerveux des Mollusques Gastéropodes pulmonés aquatiques et d'un nouvel organe d'innervation"). This last memoir most unfortunately appears to have escaped Dr. Spengel's attention, who endeavours to identify the capito-pedal sense-organs of *Patella* with a rudimentary gill, and to bring under the same denomination the often plicated problematic sense-organs of a number of other Gasteropods.

In discussing these homologies Dr. Spengel is led to expound his views on the torsion of the visceral mass of the Prosobranch Gasteropods. His views are chiefly based upon the fact, first made known by me, of the existence of two renal organs in *Patella.* Dr. Jhering, in a memoir on the morphology of the renal organ of Mollusca (Zeitschr. für wiss. Zoologie, vol. xxix. 1877, p. 605), is the only observer who has confirmed my description of the existence of two renal organs in *Patella*; and he has added similar observations on *Fissurella* and *Haliotis.* Dr. Spengel, in reference to this matter, cites only the observations of Dr. Jhering, and omits all reference to the fact that I had discovered the condition of the renal organs of *Patella* ten years before that writer, although Dr. Jhering quotes my observations at full length. The fact has some importance; for, as a natural consequence of my observations, I have, during the period which has elapsed since they were made, been in the habit of teaching the same general views as to the torsion of the visceral mass of Gasteropoda and its effect upon the symmetry of the organs as are now advanced by Dr. Spengel (explained by a woodcut on p. 351 of his paper). This writer, to establish his views, makes use of the fact first observed by me, but erroneously (and, I do not doubt, unintentionally) attributes the observation to Dr. Jhering. Speaking of organs which are paired though not fully symmetrical in certain of the Prosobranchia, he says

"Dahin gehören in erster Linie die Kiemen und die Geruchsorgane, das Herz mit seinem zwei Vorhöfen und endlich nach den Beobachtungen v. Jherings die Nieren." Further, he discusses whether one of the "von v. Jhering beschriebenen Organe" may not be identical with the anal gland of *Murex*. I am not of the opinion that it is a reasonable thing to allow one's priority in such a matter to be handed by one writer to another without making any protest. Hence these few lines.

I may add that Dr. Jhering, in his memoir published in 1877, states that he was unable to find an opening leading from the pericardium into the renal organ as described by me. During April of this year I have, with the cooperation of my assistant Mr. A. G. Bourne, examined fresh limpets as to the pericardial orifice. Its presence can be demonstrated both by injections which pass from the pericardium, sometimes into the right, sometimes into the left renal sac, and by dissection. The orifice *leads directly into a narrow subanal tract of the further or right* renal sac, and not directly into the left or small renal sac, which, on account of its proximity, might have been expected to be the sac in communication with the pericardium. That the pericardial orifice should open directly into the *large*, or right, or infraanal renal organ of *Patella*, and not into the small one, is especially remarkable when we remember that it is the small renal sac which, lying dorsal and to the left of the rectum (in the primitive uncoiled condition of the visceral mass the small sac would obviously enough be to the right, and not to the left, of the rectum), would seem to correspond with the single renal sac of other Gasteropods.

II. Mr. W. K. Brooks has recently given an account, with figures, of the development of the Squid ('Anniversary Memoirs of the Boston Society of Natural History'), which, besides quotations from the writings of Kölliker, myself, and Bobretzky, contains sketches of the well-known surface-appearances exhibited by living specimens of *Loligo* at a few stages of its development. Mr. Brooks, however, is led to offer some reflections on the homologies of the arms, funnel, and yelk-sac of the embryo Cephalopod with parts of the adult Gasteropod. I cannot agree him when he says that he has "been so fortunate as to fill a gap by finding embryos which exhibit general molluscan characteristics;" and I can find nothing new in his comparison of the embryo Cephalopod with an embryo Pulmonate, excepting what I regard as erroneous. He is mistaken in quoting me as favouring a close comparison of the shell-gland discovered by me in Gasteropods and Lamellibranchs with the pen-sac of Cephalopoda, which I showed to originate, like the shell-gland, as an open invagination. I have been careful to point out reasons for doubting the exact equivalence of the two structures ("On the Development of the Pond-Snail, and on the early Stages of other Mollusca," Quart. Journ. Microsc. Sci. vol. xiv. 1874, p. 371).

Further, I cannot agree with Mr. Brooks in the view that the molluscan foot is necessarily an "unpaired" organ. It is truly enough a median organ; but it has necessarily a right and a left side, which in many cases tend to develop as two divergent lobes; and such growths as "epipodia" are only an expression of this tendency to bilateral development.

Mr. Brooks regards the arms of the Cephalopod and the funnel as either epipodial or as new and special organs of Cephalopods, whilst he advocates the view that the yelk-sac of Cephalopods represents the "median unpaired" foot of Mollusca, which has accordingly no representative in the adult Cephalopod.

Mr. Balfour, in his 'Comparative Embryology,' vol. i. p. 225, had anticipated Mr. Brooks's speculation as to the identity of the Cephalopod's yelk-sac with the Gasteropod's foot. He says:—"In Cephalopods the position of the Gasteropod foot is occupied by the external yolk-sack. In normal forms the blastopore closes at the apex of the yolk-sack, and at the two sides of the yolk-sack the arms grow out. These considerations seem to point to the conclusion that the normal Gasteropod foot is represented in the Cephalopod embryo by the yolk-sack, which has, owing to the immense bulk of food-yolk present in the ovum, become filled with food-yolk and enormously dilated."

I am unable to agree with the interpretation put upon the facts by Mr. Balfour and Mr. Brooks. I quite admit that the region in the Cephalopod distended by food-yelk is the axial region of the foot; that is obvious upon the first observation of the facts. But it is another thing to maintain that the projection or outgrowth *as such* represents the projection or outgrowth in its entirety known as *the* foot in Gasteropods. In my opinion it does not do so, but is a special embryonic dilatation of the axial region of the foot, and is no more representative of such an outgrowth as the adult muscular foot than is the very remarkable contractile sac on the foot of *Limax*.

Had Mr. Brooks compared his embryo squid with an embryo slug, he would, I think, have come nearer to making out the significance of the latter's yelk-sac than he has when comparing it to an embryo of an aquatic Pulmonate.

I was much struck by the remarkable structure and rhythmic pulsation of the sac on the foot of the embryo slug when I first studied it at Jena in 1871; and in the winter of the same year, when carrying on researches on the development of the Cephalopoda at Naples, I made the observation, first of all, that the wall of the yelk-sac of the embryo squid is rhythmically contractile, and, secondly, that the structure of that wall and its contractile elements is very closely similar to that of the contractile sac on the foot of the embryo *Limax*. I subjoin outline drawings of an embryo slug and an embryo squid, to render clear to those not familiar with these objects the position of the parts under discussion.

Fig. 1.

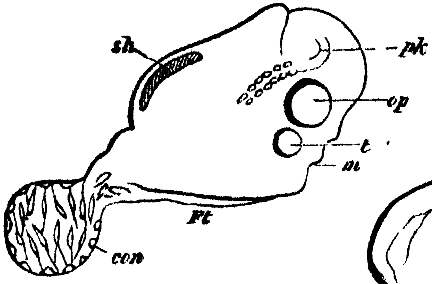

Fig. 2.

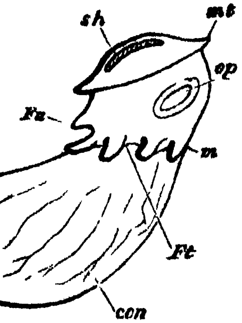

Fig. 1. Diagram of an embryo Slug.
Fig. 2. Diagram of an embryo Cephalopod. *m*, position of mouth; *Ft*, foot; *sh*, shell; *con*, contractile embryonic outgrowth of the pedal region (yelk-sac in Cephalopod); *op*, eye; *pk*, primitive kidney of slug; *t*, smaller head-tentacle of slug; *Fu*, funnel of Cephalopod; *mt*, mantle-flap of Cephalopod.

In a paper published in this magazine in February 1873 ("Zoological Observations made at Naples in the winter of 1871–72") I gave a brief outline of my results as to Cephalopod development, and I there said (p. 84):—"An interesting phenomenon is the contractility of the walls of the yelk-sac, which is observed at a very early period, as soon as the first rudiments of eyes, ears, and mouth have appeared. A rhythmic wave of contraction passes continually along the wall of the sac, at that part immediately in front of the alimentary tube, and doubtless acts so as to cause a circulation of nutrient material in the direction of the young embryo. The tissue which exhibits this contractility is of the same structure (stellate cells) as that of the remarkable contractile vesicle observed in the pulmonate Gasteropoda, and which I have studied in *Limax*. It is probable that the two parts are homogenous."

So far as any comparison between the Cephalopod yelk-sac and the Gasteropod foot is legitimate, it appears to me that I had made it in the above passage some years since.

As to the homologies generally of Gasteropod and Cephalopod, I am inclined to agree with Mr. Brooks when he says "we cannot expect any valuable results to follow from the attempt to compare any part of the body of a Cephalopod with structures which, like the epipodial folds, are not common to the Gasteropoda, but somewhat exceptional." I consider that a close relationship exists between the siphonal folds of the Cephalopod and the "pteropods" of Pteropoda, and, again, between the arms of the former and the arms (bearing suckers in *Pneumodermon*) of the latter; but there appears to be no ground for going further when we compare these parts with those of a Gasteropod than is involved in assigning them all to "the foot," which certainly cannot be given up to the sole equivalence of the yelk-sac, and is not to be limited, as Mr. Brooks would have it, to an unpaired median growth. I do not see the cogency of the arguments put forward by Jhering for regarding the arms of Pteropods and Cephalopods as distinct from foot; and assuredly it is necessary absolutely to reject Grenacher's notion of their identity with the velum, a notion with which every morphologist has at one time or other amused himself; and, lastly, there appears to be no ground capable of statement for regarding, as Brooks would do, the siphon (funnel) as a growth peculiar to the Cephalopod. Its condition in *Nautilus* alone is sufficient to show that it is a part of the molluscan foot.

XLV.—*The Structure and Affinities of* Euphoberia, *Meek and Worthen, a Genus of Carboniferous Myriopoda*. By SAMUEL H. SCUDDER*.

THE genus *Euphoberia* was established in 1868, for some remarkable spiny Myriopoda found in the ironstone nodules of Mazon Creek, in Illinois, and which were first fully described and figured in the third volume of the Geological Report of the Illinois Survey. The only characteristics then noted, in which they differ from modern types, were the tapering form of the body and the presence of branching

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* From the 'American Journal of Science,' March 1881, pp. 182-186.

spines on all the segments in longitudinal rows. An opportunity of examining a series of these animals from the same locality, due to the kindness of Messrs. Carr and Worthen, and especially of studying a fine fragment of *Euphoberia major*, M. & W., giving an admirable view of the ventral plates, proves that the differences between these ancient types and modern forms are so numerous and important as to compel us to refer them to a distinct suborder, for which the name of Archipolypoda is proposed.

One main distinction between the two groups, Diplopoda (or Chilognatha) and Chilopoda, into which existing Myriopoda are generally divided, consists in the relation of the ventral to the dorsal plates of the various segments of which the body is composed. In the Chilopoda there is a single ventral plate, bearing one pair of legs, for every dorsal plate; in the Diplopoda, on the contrary, there are two such ventral plates, each bearing a pair of legs, for every dorsal plate (with the exception of a few segments at the extremities of the body). The Diplopoda are universally considered the lower of the two in their organization; and it is therefore not surprising to find that no Chilopoda have been found in rocks older than the Tertiary series*; while Myriopods with two pairs of legs corresponding to each dorsal plate may be found as far back as the Coal-measures. In such comparisons as are here instituted, the Chilopoda may therefore be left out of account.

In modern Diplopoda each segment of the body is almost entirely composed of the dorsal plate, forming a nearly complete ring; for it encircles, as a general rule, nine tenths of the body, leaving small room for the pair of ventral plates. On the side of the body it is perforated by a minute foramen, the opening of an odoriferous gland. Usually the ring is nearly circular; but occasionally the body is considerably flattened, and the sides are somewhat expanded into flattened laminæ with a smooth or serrate margin; a few species are provided with minute hairs, sometimes perched on little papillæ; and the surface of the body, ordinarily smooth or at best wrinkled, is occasionally beset with roughened tubercles, which may even form jagged projections. So far as I am aware, no nearer approach to spines occurs on the dorsal plate than the serrate edges of the lateral laminæ, the roughened tubercles, or the papilla-mounted hairs.

In the *Euphoberiæ* from the Coal-measures a very different condition of things obtains. The segments of the body

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* *Geophilus proavus*, Germ., from the Jura, is certainly a nereid worm, as stated by Hagen.

may be circular, or laterally compressed, or, as in many modern types, depressed; but in all the dorsal plate occupies scarcely more than two thirds of the circuit of the body, or even less, being opposed by broad ventral plates. This dorsal plate is not perforated for foramina repugnatoria*, but, as means of defence, it is armed with two or three huge spines upon either side: one row (for they occur on all the segments alike) lies above, near the middle line of the body; another is placed low down upon the sides, near the lower margin of the dorsal plate; and a third row is sometimes found between them. These spines are sometimes forked at the tip; and they are (probably) always provided to a greater or less extent with spinules springing from the base or the stem; sometimes these are so numerous as to form a *whorl* of little spines around the main stem. Usually the main spines are at least half as long as the diameter of the body; often they are as long as the diameter; and one may readily picture the different appearance between one of these creatures, perhaps a foot or more in length, bristling all over with a coarse tangle of thorny spines, and the smooth galley-worm of the present day.

If we pass to the ventral plates we shall find differences of even greater significance. In modern Diplopoda these plates are minute; the anterior forms the anterior edge of the segment, continuous with that of the dorsal plate; together, however, they are not so long as the dorsal plate at their side; and the latter appears partly to encircle the posterior of the ventral plates by extending inward towards the coxal cavities. The legs are attached to the posterior edge of each ventral plate; and those of opposite sides are so closely crowded together that they absolutely touch. The stigmata, of which there is a pair to each ventral plate, are placed at the outer edge, rather towards the front margin; and their openings are longitudinal (*i. e.* they lie athwart the segment); the coxæ of the legs of the anterior plate are therefore opposite the stigmata of the posterior plate. No other organs are found upon the ventral plates; one might indeed say there was not room for them. The legs themselves are composed of six simple cylindrical joints subequal in length, the apical armed with a single terminal claw; the whole leg is short, generally not more than half as long as the diameter of the body.

In the ancient *Euphoberiæ* all is very different. The ventral

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* This is what would be expected from the presence of spines; for two such means of defence should not be looked for in the same animal; offensive glands are present only in slow-moving or otherwise defenceless creatures, as in Phasmidæ among Orthoptera for example.

plates occupy the entire ventral surface, perhaps may be said to extend partly up the sides of the rounded body; and no part of the dorsal plate passes behind the posterior ventral plate. They are together equal in length to any part of the dorsal plate, the segments of the body being equal in length throughout; while in modern Diplopoda the upper portion of the dorsal plate is always considerably longer than the ventral portion, allowing the creature to coil ventrally without exposing any intersegmental portion of the back devoid of hard armature: in these ancient forms the animal appears to coil dorsally as readily as ventrally; at least, when not extended straight upon the stones in which they are preserved, they are as frequently found bent upward as downward; and there is certainly nothing in their structure to prevent such mobility.

Then the legs, instead of being inserted at the extreme posterior edge of the plate, are planted almost in its very centre, and are indeed so large that they occupy nearly its entire width; neither are those of opposite sides inserted close together, but are removed from one another by a space equal to their own width, giving them ample play. The legs themselves differ from those of modern types in having the second joint as long as the others combined, and the whole leg at least as long as the diameter of the body, and sometimes nearly twice as long; moreover they are not cylindrical but compressed and slightly expanded, strengthened also on the flattened surface by longitudinal carinæ, and in every respect, in those specimens in which the legs are best preserved, have the aspect of *swimming-organs*. No aquatic forms are known among recent myriopods.

The stigmata, instead of having the position they hold in modern Diplopoda, where they are necessarily minute, are very large, situated in the middle of each ventral plate, each spiracle opposite to and indeed touching the outside of the coxal cavity of the plate to which it belongs, and running therefore with and not athwart the plate, *i. e.* across the body. But in addition to these structures, which make up the sum of the furniture of the ventral plate in modern Diplopoda, we find in these ancient myriopods some further interesting organs, which are so perfectly preserved that no doubt can be entertained concerning their presence and their adherence to the ventral plate. The coxal cavities are not circular but oval, and are situated with the major axis in an oblique line, running from near the middle line of the body forward and outward: this and the slight posterior insertion of the legs leave even a wider space between them at the anterior border of the plate than at the posterior; and this place is occupied by a pair of peculiar organs, situated one on either side of the median line at the very front edge of every ventral plate. These, I think, may be supports for branchiæ; they consist of little triangular cups or craters, projecting outward from the under surface, through which the branchial appendages protruded. Until recently no other organs than branchiæ had been found in any arthropod, situated within the legs, and repeated on segment after segment. The only exceptions known are *Peripatus*, a strange creature, allied certainly to the myriopods, but of lower organization, in which Balfour has found segmental organs (heretofore known only in worms) having their external openings somewhat similarly situated, and *Scolopendrella*, a minute chilopodous myriopod, in which Ryder has just described organs which he calls tracheæ, opening externally between the legs. But as branchiæ also occur *together with spiracles* in some low-organized insects, and then in essentially similar relative positions to that in which they are here found, and as the possession of legs adapted to swimming leads us to presume in these creatures an aquatic or amphibious life, it would seem as if we might fairly conceive these crateriform appendages to be branchial supports*, and conclude that we are dealing with a type of myriopods very different from any existing forms—suited to an amphibious life, capable of moving and breathing both on land and in water. Moreover the assemblage of forms discovered in the Mazon-Creek beds lends force to this proposition; for the prevalence of aquatic Crustacea, of fishes, and ferns indicates that the fauna and flora were those of a region abounding in low and boggy land and pools; and the presence of marsh-frequenting flying insects does not contradict such a belief.

These, however, are not the only points in which the ancient forms differed from the recent. We have so far examined only a typical segment; let us now look at the body as a whole and at special segments. The modern Diplopoda are of uniform size throughout, tapering only at the extreme tips; while these ancient forms, at least when seen from above, diminish noticeably in size towards either end, and especially towards the tail, giving the body a fusiform appearance, its largest part being in the neighbourhood of the seventh to the tenth body-segments, which were often two, or even three, times broader than the hinder extremity, and considerably broader than the head or the first segment behind it. A single segment seems to have carried all the appendages related to

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* Even if they were segmental organs, they may still have been connected with respiration.

the mouth-parts, while in modern Diplopoda two segments are required for this purpose: this peculiarity of the fossil is inferred solely but sufficiently from the fact, perhaps even more remarkable, that every segment of the body (as represented by the dorsal plates), even those immediately following the single head segment, is furnished with *two* ventral plates and bears *two* pairs of legs. As is well known, each of the segments immediately following the head-segments in existing Diplopoda bears only one ventral plate and only a single pair of legs—a fact correlated with the embryonic growth of these creatures, since these legs and these only are first developed in the young diplopod. The mature forms of recent Diplopoda therefore resemble their own young more than do these Carboniferous myriopods—a fact which is certainly at variance with the general accord between ancient types and the embryonic condition of their modern representatives, and one for which we can offer no explanatory suggestion worth consideration.

Unfortunately the preservation of the appendages of the head in these Carboniferous forms is not sufficiently good in any that have yet been found to allow any comparison with modern types. This is the more to be regretted since those parts are those on which we depend largely for our judgment of the relationship of the Myriopoda to other Insecta and to Crustacea. If they were present and sufficiently well defined, we may well suppose that they would afford some clue to the genetic connexion of these great groups.

The structure of the Carboniferous *Euphoberiæ* has thus been shown to differ so much from that of modern Diplopoda that, as stated at the outset, we seem warranted in placing them in a group apart from either of the suborders of modern Myriopoda and of an equivalent taxonomic value.

Cambridge, U.S., January 7, 1881.

XLVI.—*Polyzoa, Cœlenterata, and Sponges of Franz-Joseph Land.* By STUART O. RIDLEY, B.A., F.L.S., Assistant in the Zoological Department, British Museum.

[Plate XXI.]

THE specimens here to be described were collected by Mr. Grant, the naturalist accompanying Mr. Leigh Smith in his cruise last autumn to Franz-Joseph Land and Spitzbergen. They were presented by the latter gentleman to the British Museum, and form the first collection from the former locality which has yet been worked out. They were all obtained at one locality, viz. lat. 79° 55′ N., long. 51° 0′ E., or at about the same latitude as the extreme south of Wilczek Island, and the same longitude as Eira harbour, on the south-west coast of Franz-Joseph Land; the station appears thus to have been at some distance from land. The depth is not known. Mr. Miers * has already described the Crustacea and Pycnogonida obtained at the same time.

I had hoped that a study of the above groups of the fauna of this newly-discovered coast might lead to some indication of the connexions which the land bears to the neighbouring arctic lands, Greenland, Spitzbergen, or the land west of Smith's Sound, or to a possible polar sea.

It is known that a rapid current sets down the straits which divide the tract known as Franz-Joseph Land from that called Wilczek Land, and that, probably in consequence of this, the water here is free from ice at an earlier and a later time in the year than is usual in such latitudes. This current may either be due to the remains of that branch of the Gulf-stream which sweeps up the western shore of Spitzbergen, and which, if this hypothesis is correct, would pass on northwards past a north-western angle of Franz-Joseph Land to enter the northern end of its great straits; or it may be due to some polar current derived from an open polar sea. The fact that the current is coexistent with an unusually open condition of water speaks for the theory that it is a *warm*, not a cold one, such as a polar current would be, while the relations of the fauna of the coasts which are bathed by this current appear also to point to the conclusion that its communications are with the eastern (*i. e.* the Spitzbergen and Novaia Zemlia), not the western (*i. e.* Greenland and Smith's Sound) divisions of the polar area, and in consequence do not support the theory of an open polar sea. To arrive at some idea of the faunistic relations of this coast, a Table has been added below to show the relations of its species to those of the other polar tracts. It is seen at once, even with the small number of species (twenty-two) here cited, how nearly most of the arctic seas are related to each other in regard to these branches of the fauna; but Smith's Sound, the main western approach to the Pole, appears to diverge from Franz-Joseph Land more widely than any of the other districts (with the exception of Iceland and East Greenland, from which very few species in all are known), only four species being at present known common to both—a conclusion supporting that which was above favoured, in regard to the non-existence of an open polar sea connecting it with Franz-Joseph Land.

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* Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 45.

With respect to the zoological aspects of the fauna, we miss the familiar Spitzbergen *Hornera*, *Membranipora lineata*, *Menipea ternata*, &c.; and none of the new forms described by Mr. Hincks from the Barents Sea have reappeared here. The only possibly new species is that described provisionally as a variety of the well-known British and arctic *Mucronella ventricosa*. Cœlenterata and Sponges are not more than represented. However, considering that but one station was worked, the results may be said to be interesting as pointing to the existence of a great eastern boreal as distinguished from a small western polar Polyzoan subdistrict.

POLYZOA.

CHILOSTOMATA.

Menipea arctica, Busk.

Menipea arctica, Busk, Quart. Journ. Micr. Sci. iii. p. 254, pl. i. figs. 4–6.

In great abundance; no trace of an operculum observed in any specimen; so Smitt must, as Busk (Journ. Linn. Soc. xv. p. 232) implies, have united two species under his *Cellularia ternata*, forma *gracilis*. Number of cells in an internode 4 or 5. A distinct variety occurs with *two* spines on upper margin of cell. The cell in which the root-fibre originates is oval, and from its position, which is usually immediately above the orifice of a cell, is liable to be taken for an ovicell. No ovicells observed. Lateral avicularia not uncommon.

On *Alcyonidium gelatinosum* &c.

Scrupocellaria scabra, Van Beneden.

Cellarina scabra, Van Beneden, Bull. Acad. Roy. Belg. xv. p. 73, pl. i. figs. 3–6.

Scrupocellaria scabra, Hincks, Hist. Brit. Mar. Pol. p. 48, pl. vi. figs. 7–11.

Differs in some important points from the form of this species figured by Hincks, agrees better with Van Beneden's North-Sea specimens; thus the operculum generally covers the entire aperture of the cell, and, with the exception of a tilting-up of the upper edge, the surface is flat, not concave. Two spines are commonly found on the outer edge of the aperture. Internodes short, consisting of either 2, 3, or 4 cells, exclusive of the median cell of the furcation. The anterior avicularia occur, as a rule, only below the lowest cell but one of the internode and the median cell of the furcation.

Vibracular cells and rooting-fibres absent from terminal internodes.

A small colony, 6 millim. high, on *Escharoides Sarsi.*

Gemellaria loriculata, Linné.
(Pl. XXI. fig. 1.)

Cellularia loriculata, Pallas, Elench. Zooph. p. 64.
Gemmellaria loriculata, Van Beneden, Recherches Bryoz. p. 33, pl. v. figs. 1–6.

Has the form depicted in Van Beneden's figures (*l. c.*): the slight lamina extending across the lower end of the opening, as there given, but omitted in all other representations which I have seen, is present here and adds to the beauty of the species. The cells are long, as in the same figures.

Bugula Murrayana, var. *fruticosa*, Packard.

Menipea fruticosa, Packard, Canad. Nat. viii. p. 409, pl. i. fig. 3.
Bugula Murrayana, var. *fruticosa*, Hincks, Hist. Brit. Mar. Pol. p. 93, pl. xiv. figs. 3, 5.

Some fragments agreeing generally with the best-known form of this variety, viz. that with 2 to 4 series of cells in its dichotomously dividing branches. The outer upper angle of the cells is sharply angular rather than spined; generally a spine on each side a little below the top, never more than one. Avicularia of the smaller size only. The cell-characters agree well with those of Busk's fig. 1, pl. xii., Journ. Linn. Soc. xv.

Flustra carbasea, Ellis & Solander.

Flustra carbasea, Ellis & Solander, Hist. Zooph. p. 14, pl. iii. figs. 6, 7.
Eschara papyrea, Pallas?, Elench. Zooph. p. 56.

A few of the cells are decidedly subrhomboidal as seen from the back of the frond; hence, perhaps, Pallas's description of the cells in his specimen as being rhombic; for the description agrees well in its other points, except that of "apice superiori truncato," with this species.

A fine colony attached to a valve of a bivalve shell.

Flustra securifrons, Pallas.

Eschara securifrons, Pallas, Elench. Zooph. p. 56.
Flustra securifrons, Smitt, Œfv. Akad. Förh. 1867, p. 378, pl. xx. figs. 6–8.

A fine colony. The branches are decidedly dilated at their tips. But one ovicell was observed in the whole colony; so, though probably others were present, they are scarce.

Membranipora Sophiæ, Busk.
(Pl. XXI. fig. 2.)

Membranipora Sophiæ, Busk ?, Quart. Journ. Micr. Sci. iii. p. 255, pl. i. fig. 7.

I have little doubt that two colonies in this collection, the one growing inside the lip of a univalve shell, the other on the base of a specimen of *Alcyonidium gelatinosum*, belong to this species; if so, however, Mr. Busk's figure and those given by Smitt (Œfv. Akad. Förh. 1867, pl. xx. figs. 24, 25, 27) need supplementing by a more detailed one.

In these specimens the zoœcia are large, distinct, with raised edge, oval, or very commonly smaller at the distal than at the proximal end; the area has a very slightly projecting calcareous rim, which is minutely fimbriated. On the edge, at each side of the mouth, are two pointed avicularia on short peduncles, the apices projecting upwards and backwards. One, two, or three pairs of spines occur below these avicularia on the edge. The oœcia are remarkable for singular modifications of form. In the simplest form they are oval, of medium size, smooth, with the exception of some striæ radiating up and backwards from the mouth; the mouth is provided with a very slightly upwardly-projecting lip. In the next stage a longitudinal ridge runs down the surface of the oœcium. In the next the rims of the neighbouring cells, of which the lateral ones touch the oœcium, while the posterior one is some distance off, surround it like a frame, and become prominent, and at the same time a horizontal ridge runs across its surface and joins the two prominent lateral walls; the upper lip of the mouth at the same time becomes much developed. Finally the anterior portion of the oœcium, viz. that enclosed between the lateral rims, the horizontal ridge, and the lip of the mouth, becomes depressed, so that the whole space above the cell appears to be occupied by two rectangular areæ, and the oœcium itself has become much less convex than at first, and is almost entirely disguised by the structures added to it. The cells radiate regularly from the centre.

Homologies of Parts of the Oœcium.—This oœcium is one of the most complicated in external characters which occur in the Chilostomata; and it would be interesting if the morphological significance of its different parts could be determined. The occurrence of several of what appear to be stages of its progressive development in one specimen seems to afford some opportunity for making deductions on the subject. Probably the large front depression of the last stage, with its surrounding raised margin, represents a rudimentary avicularium, as such is the condition by which both zoœcia and sessile avicularia first originate. A similar depression, though without the distinct raised margins, occurs in a similar position in *M. Flemingi*, Busk; and the avicularium itself of course appears in *M. Dumerili* and *M. unicornis*, Fleming. Unfortunately Mr. Hincks, when describing (Hist. Brit. Mar. Pol. p. civ) the development of the oœcial ectocyst, does not give that of the oœcium, and I know of no other account; hence the homologies of the different parts of the oœcium can be hardly more than guessed at. The radiating furrows or ridges which are seen in some oœcia, and are indicated in one stage of this one, may perhaps indicate that it is primitively constructed by the growing together of paired trabeculæ similar to those which probably unite to make up the zoœcial cell-front in the Chilostomatous forms (see Hincks, *l. c.* p. 184, on the genus *Cribrillina*, and his description of *transverse striæ* in the primitive covering of the cell of *Mucronella coccinea* at the second developmental stage, p. civ). The oœcium of adult *Reteporæ* has a median cleft; and in one species this is represented by an invagination from the lower edge: this is probably the remains of an embryonic median cleft, common to all typical Chilostomata, and represents the ununited edges of the cell, this stage corresponding to stage 2 of Hincks's history of the zoœcium of *Mucronella coccinea*.

The median ridge or galeate process, seen here in one stage, and also found in *M. aurita*, Hincks, *Micropora coriacea*, Esper, *Chorizopora* (*Lepralia*) *Brongniarti*, Busk, and *Steganoporella Smitti*, Hincks, perhaps represents the point of union of the two edges of the oœcium, strengthened by additional calcareous matter.

Membranipora craticula, Alder.

Membranipora craticula, Alder, Trans. Tyneside Nat. F. Club, iii. p. 144, pl. x. fig. 3.

Two colonies with the typical characters. The one has the surface beautifully hyaline; the other was apparently taken dead, and is consequently granular and deficient in some of its parts. The number of spines is, as a rule, 12 to 14. The bar crossing the surface of the oœcium is well marked; and the lateral or median avicularium is also generally present here, though not invariably. The avicularium below the cell is often very prominent, owing to the mound on which it is placed; this point serves to bring the species still nearer to *M. lineata*, Linn., from which it is now to be distinguished chiefly by the slender characters of shape and position of the spines; for the *numbers* of these are as often as not 12 in this species, which is the maximum number assigned by Hincks to *M. lineata.*

Anarthropora monodon, Smitt.

Lepralia monodon, Busk, Quart. Journ. Micr. Sci. viii. p. 213, pl. xxix. figs. 3, 4.
Anarthropora monodon, forma *minuscula*, Smitt, Œfv. Akad. Förh. 1867, Bihang, pp. 7, 64, pl. xxiv. figs. 20–24.

In one of the four colonies which occur in this collection the cells are subrhomboidal, and have in some cases a small pore on the raised area above as well as below the mouth. The rhomboidal shape is not confined to the cells of this colony. The connexion between the special pore of the Porinidæ and the oral sinus of the Myriozoidæ is instructively illustrated by examples of some of the younger cells, which show the gap connecting the infraoral pore with the mouth not yet closed, and, in fact, represent a Myriozoid stage of a Porinid cell.

The pores never become converted into avicularia as in Smitt's "forma *majuscula.*"

Myriozoum subgracile, Smitt.

Myriozoum subgracile, D'Orbigny?, Paléontologie Française, iii. p. 662; Smitt, Œfv. Vet. Förh. 1867, Bihang, pp. 18, 119.

It appears to me that the species described by Packard (Canad. Nat. viii. p. 411) is rightly assigned to this species, but that he does wrong in calling attention to the annulate character of the branches as showing its identity with *Millepora truncata*, Fabricius; for this is too slight, in both the present and all other specimens which I have examined, to have been noticed by Fabricius, whose description seems to me to refer to *M. coarctatum* of Sars. A portion of a colony occurs here, presenting the characters usually found in arctic specimens; the diameter of the branches is a trifle more than 1 millim.

Myriozoum crustaceum, Smitt.

Myriozoum crustaceum, Smitt, Œfv. Vet. Akad. Förh. 1867, Bihang, pp. 18, 114, pl. xxv. figs. 88–91.
Leieschara crustacea, id. ibid. 1878, p. 20.

Four colonies, one of which has the central part stained pink, the marginal parts remaining pale yellowish white. Cancelli very large and evident in the lateral cells, where they are much extended longitudinally and are larger than those of Smitt's figs. 88, 89; scarcely developed in those of the centre. Limits of younger cells undefined, those of the older cells more evident, owing to their greater convexity. Mouth of cell well represented by Smitt's figures; in one case the form was that of fig. 77*a* on the same plate (*Eschara secundaria*); the hinder part is deeply sunk. Lateral avicularia may be absent or only one to a cell, generally distinct and elevated on prominences which are distinctly tubular and more prominent than those of Smitt (fig. 91), who finds them only in the more calcified cells. Avicularian opening round or slightly oval. No oœcia present.

One colony occurred on frond of *Flustra carbasea*, Ell. & Sol., the others on a univalve shell, &c.

Mr. Hincks (Ann. & Mag. Nat. Hist. [5] vi. p. 274) refers this species to "*Schizoporella plana*, Dawson;" but I am unable at present to find the description alluded to.

Schizoporella cruenta, Norman.
(Pl. XXI. fig. 4.)

Lepralia violacea, var. *cruenta*, Busk, Cat. Mus. Brit. ii. p. 69, pl. cx. fig. 1.

Lepralia cruenta, Norman, Ann. & Mag. Nat. Hist. (3) xiii. p. 88.

Schizoporella cruenta, Hincks, Hist. Brit. Mar. Pol. p. 270, pl. xxx. fig. 5.

Two dead colonies, and one very fine colony taken when mostly alive; the latter measures 23 millim. by 19 millim. The differences of colour in the different parts of the latter specimen are striking. In the centre, which had died before the specimen was taken, it is dirty white; immediately outside is a zone of cells of a pink colour (not *deep* red); the margin is formed by a broadish band of cells of a bright brown colour, shading into pink towards the centre. The different forms of the zoœcium correspond well with those given in Hincks's figure (*l. c.*); but the oral sinus is well marked in most, even old cells. The surface thickenings represented in Busk's figure do not occur to any thing like the extent there given; but in the older cells the margin of the mouth is thick and prominent, and between some of the cells occur very prominent boundary-lines. *Oœcia*, early stages of which resemble those cells in Busk's figure which have a semicircular supraoral thickening, occur in abundance, showing all stages of transition, from the large open hood with slightly projecting rim to the perfect form, which is slightly elevated, circular, subglobose, minutely punctate, and somewhat uneven; they are inconspicuous and readily overlooked. Traces of the original wide space in the front of the hood are frequently left in the form of a pointed slit in its lower edge, bearing some resemblance to an avicularian hollow. The brown colour of the margin of the colony is evidently due to the important part played by the chitinous part of the ectocyst in the young cells, appearing as it does in the wide fenestræ of the front wall of the cell, the margin of the mouth, &c.

Porella concinna, Busk.

Lepralia concinna, Busk, Cat. Brit. Mus. ii. p. 67, pl. xcix.
Porella lævis, Smitt, Œfv. Vet. Förh. 1867, Bihang, pp. 21, 134, 217, pl. xxvi. figs. 117, 118.
Porella concinna, Hincks, Hist. Brit. Mar. Pol. p. 323, pl. xlvi.

Several colonies. They agree with Busk's figs. 1, 3, 4, 5, and the two cited figures of Smitt better than with any others designed to represent this species. The marginal punctures are constant. The cells are generally separated by a prominent and undulating line. The inferiorly enlarged peristome, which encloses the avicularium is sometimes almost as prominent as in *P. struma*, Hincks (Norman). In some young cells a semilunar hollow in front of the mouth marks its future position, showing that it owes its character to the avicularian chamber which it contains, and which is afterwards perfected by the extension over this hollow of the surrounding calcareous margin, just as the zoœcium itself is formed by calcareous growths from its margin. The avicularian chamber is liable to become accidentally detached; and then it leaves a round space below the mouth of the adult cell: this condition appears to be represented by two of the upper cells of Busk's fig. 5 (*l. c.*).

A small circular incrusting colony is also referred, but with doubt, to this species. It has an umbo immediately below the lower lip, but apparently no avicularium there. The cells are convex and distinguished from each other by their convexity; but there is no bounding line. No spines. The front of the cell is covered, excepting the base of the umbo, with coarse foramina. Cells slightly rhomboid. The intraoral denticle is rectangular. No oœcia.

A large spreading colony 24 millim. in extreme diameter is apparently also referable to this protean species. On one side the front of the cell is almost entirely occupied either by an immense and very salient rostrum, in the oral side of which lies the avicularium, or by a large depressed space, oblong or semilunar, beneath which the wall of the cell is thin. The cells with these spaces evidently constitute an earlier stage than the rostrated cells; and the rostrum, when it occurs, together with its contained avicularium, is evidently developed over such a space. At the opposite side of the colony the cells are flattish, with a central rather minutely tuberculated area; the sides of the cells are formed by smooth spaces containing a few coarse perforations; there is a slight approach to a rostrum immediately below the mouth. This form is well represented by the two left-hand cells of Busk's pl. xcix. fig. 4. A broad rounded denticle lies within the mouth in all these forms; the oœcium is globose, tuberculate, slightly prominent.

Hab. On large univalve shells.

The numerous variations exhibited by this species are, as Hincks remarks (*loc. cit.* p. 324), mainly due to superficial differences; the form of the mouth, the denticle (except in the doubtful specimen, in which it is rectangular), the infraoral avicularian rostrum (or the depressed space representing it), the marginal punctures maintain the same general characters throughout. No spines, or traces of them, however, were observed in any cells; but as Hincks only figures them in one case and Busk not at all, they must be regarded as very rarely occurring.

The possibility of the presence or absence of avicularia in different specimens of the same Polyzoan species would be a striking fact if it were determined to be a real possibility; it would, however, be interesting to determine whether, as in this case, the absent avicularium is not generally represented by the rudiments of a chamber in the surface on which it should normally occur. Occlusion of the avicularium by thickening of the cell-wall must also be allowed for when it is stated to be absent in any given species.

Mucronella ventricosa, Hassall, var. *connectens*, n. var.
(Pl. XXI. fig. 6.)

Discopora coccinea, forma ventricosa, Smitt?, pars, Œfv. Akad. Förh. 1867, Bihang, p. 172, pl. xxvii. fig. 107 only.

A small colony without oœcia, unless the remarkable prominence figured in fig. 6 *b* is an abnormal oœcial hood. It agrees neither with *M. Peachii*, Johnst., nor with *M. ventricosa*, but has several points which appear to connect the two species. The cells are large, glistening, and convex, marked with radiating tuberculated lines and a marginal row of perforations; they are arranged in regularly radiating series, separated by deep furrows. The mouth is constant in the possession of six spines; the denticle is broad, with more or less prominent lateral points, and is well represented by those given in Smitt's figure cited above. There is a considerable space, containing variously shaped fenestræ, in continuation with the marginal row of perforations, above the mouth; one pair of these fenestræ in particular resembles a pair of avicularian frames; and if they are avicularia they would appear to connect the form with *M. coccinea*. It appears to have no connexion with *M. simplex*, Hincks, of the Barents Sea.

Obs. The form is certainly nearer to *M. ventricosa* than to *M. Peachii* in both its general and more special characters; it is to be hoped that more adult specimens may be obtained to decide the questions raised by its peculiarities.

Escharoides Sarsi, Smitt.

Eschara rosacea, Sars, Förh. Vid.-Selsk. Chr. 1862, p. 141.
Escharoides Sarsii, Smitt, Œfv. Akad. Förh. 1867, Bihang, pp. 24, 158, pl. xxvi. figs. 147–154.

A fine tip of an Escharoid colony, closely resembling that depicted in Smitt's fig. 147 (*loc. cit.*); reddish brown in colour. The mouth is well represented in Smitt's fig. 150. The avicularium within the mouth was the only one observed.

CYCLOSTOMATA.

Crisia denticulata, Lamarck.

Cellaria denticalata, Lamarck, Anim. s. Vert. (2) ii. p. 182.
Crisia denticulata, Milne-Edwards, Ann. Sc. Nat. (2) ix. p. 201, pl. vii. fig. 1.

Several small colonies, not exceeding 8 millim. in height. Fronds broad, from two to four zoœcial tubes in the breadth. Internodes sometimes short; joints between them inconspicuous, often brown-coloured. Openings of cells almost round.

Oœcia numerous; rings surrounding oœcium seldom perceptible; openings of oœcia rare or absent.

Lichenopora verrucaria, Fabricius.
(Pl. XXI. fig. 5.)

Madrepora verrucaria, Fabricius, Fauna Grœnlandica, p. 430.
Lichenopora verrucaria, Hincks, Hist. Brit. Mar. Pol. p. 478, pl. lxiv. figs. 4, 5.

Seven colonies. Lip frequently bidentate. On *Flustra carbasea* &c.

Septal Structures in Lichenopora.—In one of the older colonies the zoœcia exhibit a very distinct horizontal diaphragm crossing their cavity at various depths; it is perforated in the centre by a small orifice. This structure is apparently represented, though somewhat indistinctly, by Smitt (Œfv. Akad. Förh. 1866, pl. xi. fig. 3); but the zoœcial tubes which contain it are taken by him for oœcial funnels; hence his somewhat puzzling statement that eight such funnels exist in the specimen figured, the normal number being two or three. These structures probably represent the "diaphragmes transverses" of Haime (Mém. Soc. Géol. France, 2e sér. v. p. 210), the "septa" of Busk (Crag Polyzoa, p. 122, pl. xix. fig. 6), Waters (Journ. Roy. Micr. Soc. ii. p. 390) shown to occur in *Heteropora*, and called "tabulæ" by Nicholson (Ann. Nat. Hist. ser. 5, vol. vi. p. 338). The spines of the zoœcial tubes of some *Heteroporæ* and of the cancelli of some *Lichenoporæ*, together with the perforated diaphragms which replace the latter in other species of *Lichenopora*, are probably all homologous with each other and with the present structures in the zoœcia of *L. verrucaria.* I have not seen them elsewhere mentioned as occurring in this genus, and have therefore thought them worthy of a figure.

Two small specimens have the cancelli and the bases of the zoœcial tubes obscured, apparently by an overgrowth of calcareous matter resembling that described by Hincks (*loc. cit.* p. 479) as an outgrowth of the oœcium.

Heteropora pelliculata, Waters?
(Pl. XXI. fig. 3.)

Heteropora pelliculata, Waters?, Journ. Roy. Micr. Soc. ii. p. 391, pl. xv. figs. 1–4, 7.

Two very young colonies of what I have little doubt is this species, though their extreme youth renders it almost impossible to speak with certainty. They consist of dome-shaped, hemispherical incrusting growths, the one 2½, the other 4 millim. in diameter, occurring on a univalve shell.

The surface of the colony, at a point halfway between the centre and edge, has polygonal zoœcial orifices at regular intervals, each surrounded by a more or less regular circle of small cancelli, as in fig. 7 *b* of Waters's plate (*loc. cit.*); at the edge, however, the number of cancelli is much smaller and they are larger than at the centre: they originate just in the same way as the zoœcia themselves; and the outermost ones resemble closely the earliest stage of the zoœcia in *Lichenopora* (*Discoporella*). At the actual centre the zoœcial orifices themselves are larger than those near the edge; the cancelli are larger than in the halfway zone.

The genus is already known from New Zealand, Australia, and the Japanese Seas, and in the fossil state; its recent distribution is now extended to the Arctic regions. Some of Mr. Busk's figures of *Heteropora* in the 'Crag Polyzoa' appear to represent young colonies of branching forms; but the present specimens represent an earlier stage still, and serve to show by their general appearance how little really separates the genus from such forms as *Lichenopora*. If there were not such good reason to regard them as but a young stage of a branching form, they would fall naturally into the connecting genus *Heteroporella*, Busk.

CTENOSTOMATA.

Alcyonidium gelatinosum, Linné.

Alcyonium gelatinosum, Linné, Syst. (12) p. 1295.
Alcyonidium gelatinosum, Johnston, Brit. Zooph. (2) i. p. 358, pl. xxviii. figs. 1–3.

Two very distinct forms, the one including seven specimens, elongated, finger-like, not branching or proliferating, rising from a very thin pedicel; a thick firm cortex, which is of dark colour in strong spirit. The central parenchyma contained numerous embryos in one of the specimens. The other group is composed of much narrower stems, generally rounded, but tending to become palmate, profusely branched; the cortex is thin and flexible, and the colour a pale brown in strong spirit; ten to twelve specimens of this form occurred.

One specimen belonging to the first form appeared to have lived free and unattached; and the deeply constricted condition of another of the same series of specimens appears to indicate that the distal ends of such colonies may become detached in life by natural fission.

ANTHOZOA.

Peachia, sp.

This genus appears to be not uncommon in the Arctic seas (*cf.* Lütken, 'Arctic Manual and Instructions'); but drawings taken on the spot are required for satisfactory identification of the species.

Two specimens in spirit occur in this collection, one contracted, and the other expanded but injured, each 5½ millim. in height. Column cylindrical, height about the same as breadth, tapering slightly to posterior end, which is rounded and has an orifice; the margin bears the single cycle of tentacles; no apertures on surface, but minute warts (?) in fine longitudinal ridges; colour dull flesh-tint at present. Tentacles apparently in one cycle on margin, few, short, thick, blunt; of pale flesh-colour on external, cream-coloured on oral aspect. Disk flat, cream-coloured. Margin of mouth thrown into a complicated system of several deeply separated projecting tentaculoid lobes (conchula) of a decided yellow colour. The tentacles and surface of column were examined for thread-cells, none of which were discovered. In its coloration and the characters of the conchula this species appears to be related specially to *P. hastata*, Gosse.

HYDROZOA.

Sertularella tricuspidata, Alder.

Sertularia tricuspidata, Alder, Trans. Tyneside Nat. F. Club, iii. p. 111, pl. iv. figs. 1, 2.
Sertularella tricuspidata, Hincks, Brit. Hydr. Zooph. p. 239, pl. xlvii. fig. 1.

Several pieces, representing three or four colonies at least; robust, with the exception of one rather thin-walled colony; one colony attained a height of $2\frac{5}{12}$ inches (61 millim.). A few gonothecæ occurred, but all wanting their uppermost end. The time of year (late summer) at which they were collected evidently accounts for this agreement in the incipient dissolution of these bodies, and points to the time at which reproductive activity ceases in this species in this latitude.

SPONGIIDA.

CALCAREA.

Clathrina coriacea, Montagu.

Spongia coriacea, Montagu, Wern. Mem. ii. p. 116.
Grantia coriacea, Johnston, Brit. Spong. p. 183, pl. xxi. fig. 9.
Ascetta coriacea, Häckel, Kalkschwämme, ii. p. 24, pls. iii. & v. fig. 2.

A fragment, apparently torn from a *Soleniscus*-growth; the diameter of the tube must have been about 1·5 millim. Colour opaque white. The spicules have the somewhat inequiradiate character which I have recently found in those of a specimen from South America; their rays measure respectively ·10135 by ·0079, ·076 by ·0079, ·076 by ·0079 millim. average maximum dimensions, and should therefore be described as "sagittal" according to Häckel's nomenclature. The difference in length between the rays is not so great in some of the spicules.

Dr. Gray's genus *Clathrina* (P.Z.S. 1867, p. 557) has the priority of Häckel's *Ascetta*, published in 1872.

This widely spread species has already been recorded from the Arctic regions, viz. by Mr. Carter ('Annals,' ser. 4, vol. xx. p. 38) from Smith's Sound, and from the European side of the Pole (Barents Sea) by Von Marenzeller (Denk. Ak. Wien, xxxv. p. 371).

Distribution of Franz-Joseph-Land Polyzoa in the Arctic Area.

	Finmark[1].	Spitzbergen[1].	Barents Sea[2].	Novaia Zemlia[1].	Kara Sea[1].	Smith's Sound[3].	Greenland (without locality)[1].	West Greenland[4].	East Greenland[5].	Iceland[6].
POLYZOA CHILOSTOMATA.										
Articulata.										
Gemellaria loriculata	*	*	*	*	*					
Bugula Murrayana, var. fruticosa	*	. .	. .	. .	. .	*	. .	*		
Scrupocellaria scabra	*	*	. .	*	*	*	. .	*	. .	*
Menipea arctica	. .	. .	*	. .	. .	. .	. .	*	*	
Inarticulata.										
Flustra carbasea	. .	*	. .	*						
—— securifrons	*	*								
Membranipora Sophiæ	*	*	*	. .	. .	. .	. .	*		
—— craticula	*	*	*	*	*	. .	. .	*		
Anarthropora monodon										
Myriozoum crustaceum	*	*	. .	*	*	. .	*			
—— subgracile	. .	*	*	*	*	*	*	*		
Schizoporella cruenta	*	. .	. .	*	. .	. .	. .	*		
Porella concinna	*	*	. .	. .	. .	. .	*			
Escharoides Sarsi	*	*	*	*	*	. .	*	*		
Mucronella ventricosa, var. connectens										
CYCLOSTOMATA.										
Crisia denticulata										
Lichenopora verrucaria	*[6]	*	*	*	*	. .	. .	*	*	*
Heteropora pelliculata?										
CTENOSTOMATA.										
Alcyonidium gelatinosum	*	*	*	*	*	. .	. .	*	*?	
HYDROZOA.										
Sertularella tricuspidata	*[5]	*[5]	*[6]	. .	. .	. .	. .	*[6]	*[5]	*[6]
ANTHOZOA.										
Peachia, sp.										
SPONGIIDA.										
Clathrina coriacea	. .	. .	*[7]	. .	. .	*[8]				

It should be noticed that more than half these species range southwards to the British seas.

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[1] Smitt. [2] Marenzeller and Hincks. [3] Busk. [4] Fabricius, Hincks, Norman, and Busk. [5] Kirchenpauer. [6] Hincks. [7] Marenzeller. [8] Carter.

EXPLANATION OF PLATE XXI.

Fig. 1. *Gemellaria loriculata*, zoœcium. × 68 diam.
Fig. 2. *Membranipora Sophiæ*, various forms of the oœcium from one colony. × about 60 diam.
Fig. 3. *Heteropora pelliculata*?: *a*, young colony, from above; *b*, same, from side. × 15 diam.
Fig. 4. *Schizoporella cruenta*, oœcia, the upper one immature. × 40 diam.
Fig. 5. *Lichenopora verrucaria*, broken zoœcia, showing perforated diaphragms. × 93 diam.
Fig. 6. *Mucronella ventricosa*, var. *connectens*: *a*, zoœcia; *b*, zoœcium, showing tooth within lip, and process of doubtful nature above mouth. × about 60 diam.

XLVII.—*On some Indian Coleoptera, chiefly from Travancore.*
By Charles O. Waterhouse.

Lucanidæ.

Odontolabis Burmeisteri, Hope.

Some very fine examples of this species have just been received from Travancore. The fully developed male resembles that figured by Hope (Tr. Ent. Soc. iii. pl. xiii.); the figure, however, does not represent the angle behind the eye as sufficiently prominent. The coloration is constant as in the figure above referred to, the suture of the elytra being narrowly lined with black as compared with *O. cuvera*. The female examples measure 24 lines; the black at the suture of the elytra, instead of being triangular in outline, as in *O. cuvera*, narrows immediately on leaving the base, and continues parallel-sided for some distance, narrowing again at the apex.

Buprestidæ.

Catoxantha cuprascens, n. sp.

Obscure cuprea; thorace crebre punctato, singulis elytris plaga obliqua flava ornatis, apice truncatis; corpore subtus purpureo olivaceo tincto; abdomine flavo.
Long. 16 lin.

General form of *C. opulenta*, Gory, but with narrower thorax, and quite differently coloured and sculptured. Head very closely and strongly punctured in front, the vertex with a longitudinal median carina. Thorax rather flat, moderately narrowed in front, not very much enlarged at the hind angles; strongly punctured, the punctures separated on the disk, crowded at the sides; with a short well-marked impressed line on each side of the base; the posteriar angles nearly right angles. Elytra smoother than the thorax, finely and thickly punctured; each with four narrow raised lines, with a very oblique oblong yellow patch near the middle.

Hab. Travancore. B.M.

This species is very distinct from all the described species of the genus, and it should be placed at the end. The fine carina on the vertex of the head is a peculiarity I have not met with in any other species.

Prionidæ.

LOGÆUS, n. g.

General characters of *Priotyrannus*. ♂. Antennæ as in that genus, but with the third joint stouter, less parallel, impressed above, and (as well as the fourth, fifth, and sixth joints) more shining on the upperside. Mandibles short, thick; the left one with a single strong triangular tooth near the apex; the right mandible triangularly dilated at the base. Eyes moderately approximate above. Labial palpi very short, the apical joint very large and irregularly ovate. The maxillary palpi moderately long and stout, the apical joint oblong. Thorax transverse; the anterior angle produced laterally into a strong acute spine, its anterior border in a straight line with the anterior margin of the thorax; in the middle the side is triangularly enlarged and furnished with a strong acute spine, with a second small spine immediately above it; behind the middle the side is strongly emarginate, the posterior angle slightly dentiform. Elytra moderately long, subparallel, a little narrowed towards the apex, the sutural angle with a small tooth. Legs as in *Priotyrannus*, but altogether stouter. Prosternal process parallel, obtuse at the apex, not narrowed at the apex as in *Priotyrannus*. Metasternum clothed with dense pile.

Logæus subopacus, n. sp.

Niger, subopacus; thorace confertim subtiliter punctato, plagis duabus (ad basin conjunctis) nitidis fortiter punctatis; elytris piceescentibus, ad basin laxe subtiliter punctulatis; abdomine pedibusque piceis.

Long. 26 lin.

Head very closely and rugosely punctured. Thorax gently convex on the disk, very slightly impressed in front and on each side within the posterior angles; on each side of the disk is a shining, triangular, strongly-punctured patch; the two patches united by a tridentate shining band which borders the base. On each side there are two spots, which are more coarsely punctured than the rest of the surface. Elytra subopaque, with some very delicate punctuation at the base; somewhat parallel, compressed laterally below the shoulders, a little narrowed at the apex, the lateral margins narrowly reflexed.

Lamiidæ.

Morimus inæqualis, n. sp.

Fulvus, dorsaliter infuscatus, omnino pilosus; capite postice maculis quatuor nigris; elytris basi depressis, medio bene convexis, ad apicem declivis, angustatis, maculis quatuor fusco-velutinis notatis.

Long. 12 lin.

Allied to *M. morimoides*, White (Ann. & Mag. Nat. Hist. 1858, ii. p. 266, *Leprodera*), but with the elytra more depressed at the base, much more convex in the middle, more declivous at the apex. The basal joint of the antennæ has on the inner side at the base an emargination; and the upper angle made by this emargination is slightly prominent in the form of an obtuse tooth. This character is visible in *M. morimoides*, but in a much less marked degree. The antennal tubercles are very prominent. On each side of the neck are two black spots. The thorax is very roughly sculptured; the lateral spine is much stronger, more prominent, but less acute than in *M. lugubris*, Fab. The elytra are less prominent at the shoulders than in *M. morimoides*, but at the middle they are more convex and broader; very coarsely granular, or covered with obtuse tubercles, some of which range themselves in two short lines at the base near the scutellum; each elytron has on the disk, some distance from the base, an irregular, dark, velvety brown spot, and beyond the middle a second, larger, triangular patch, which touches the margin but does not reach the suture. The femora and all the underside of the insect are more or less dotted with black. The antennæ of the male are rather longer than the whole insect; in the female they are shorter.

Hab. Southern India, probably Coimbatoor. B.M.

Two examples of this species were presented to this Museum by M. J. Walhouse, Esq.

Morimus plagiatus, n. sp.

Niger, dense griseo-pilosus; antennarum articulo basali ad basin

tuberculo armato; thorace rugoso; elytris albescentibus, plagis quatuor nigris velutinis ornatis.

Long. 15–17 lin.

Antennæ densely pilose, greyish white; a little longer than the whole insect, the basal joint nearly reaching to the thoracic spine, black, with a whitish line above; at the base on the inner side with a strong conical tubercle. Antennal tubercles very prominent. Neck with two blackish spots on each side. Thorax convex, rather strongly granulose, almost rugulose, the lateral spine strong and acute. Elytra almost white towards the sides and apex; flattened near the scutellum, distinctly convex and enlarged behind the middle, sloping down and narrowed at the apex; the shoulders are on a lower level than the scutellar region, rectangular, and dotted with a few small black tubercles; a few black tubercles are also ranged in a line at a little distance from the scutellum. Each elytron has two large black patches—one at some distance from the base, commencing under the shoulders and extending towards the suture; the second, subapical, somewhat triangular, with its base on the margin and its vertex towards the suture. The legs and all the underside are dotted with black.

Hab. Travancore. B.M.

I feel somewhat disposed to think that *Leprodera morimoides*, White, and the two species I have described above should be associated and form a new genus distinct from *Morimus*, in which *morimoides* at present stands. The characters would be:—the prominent antennal tubercles, the antennæ of the male not much longer than the whole insect, the basal joint at the base emarginate within, the upper angle made by the emargination more or less prominent (scarcely prominent in *morimoides*, slightly in *inæqualis*, forming a conical tubercle in *plagiatus*); the elytra rather narrowed at the base, with the shoulders depressed and on a lower level than the scutellar region. As, however, there are some species of this group of Lamiidæ with which I am not acquainted, and which may be intermediate forms, I prefer for the present leaving these species in *Morimus*.

Eutænia elegans, n. sp.

Nigra, velutina, opaca, maculis plurimis pallide flavis ornata; antennis ochraceo annulatis.

Long. 11 lin.

Velvety black, with the following very pale yellow (or sandy-white) markings:—head with a spot on each side of the vertex, and all the face, except a black spot above the clypeus; thorax with a patch on each side; each elytron with a large transverse patch (touching the side but not the suture) some distance from the base, from the middle of which a branch is emitted to the base and is carried over the shoulder; a small spot on the margin at the middle; a broad transverse band behind the middle; a spot at the apex; on the underside there is a small spot on each side of the base of the metasternum and a large triangular spot in its middle; a spot in the middle and at each side of the basal segment of the abdomen, a small spot on each side of the second segment, the third and fourth segments almost entirely yellow; the apex of the femora and apex of the tibiæ also yellow. The antennæ are black, with half the third and half the fourth joints ochreous yellow; the fifth, sixth, and seventh joints are yellow, except at their apex.

The general form of this species is very much that of *Anoplostetha lactator*; but the lateral spine of the thorax is more acute, and the thorax is broader at the anterior margin.

Hab. Travancore. B.M.

Hispidæ.

Estigmena cribricollis, n. sp.

Nigro-fusca, nitida; thorace fere parallelo, ad basin et latera crebre punctato, punctis squamis parvis pallidis instructis; elytris fortiter lineato-punctatis (punctis latera versus et ad apicem squamis parvis pallidis instructis), interstitiis alternatis ante apicem paulo elevatis, corpore subtus piceo.

Long. 7½ lin.

Nearly of the same form as *E. chinensis*, Hope (Col. Man. iii. p. 175, t. 2. fig. 1), but with the thorax more parallel at the sides. The antennæ are much longer, being twice the length of the head and thorax together. Vertex of the head finely punctured. Thorax with the middle of the front part smooth and shining, but with some very fine delicate punctuation; on each side of the disk are a few large punctures; the base and all the sides are closely and very strongly punctured, each puncture having in its middle a small pale scale; on each side of the disk there is an elongate shallow impression. The alternate interstices of the elytra are slightly and narrowly raised towards the apex; the sides beyond the eighth line of punctures are rather strongly and confusedly punctured, as is also the apical region (but not so strongly); and all the punctures being furnished with small pale scales, the sides and apex have a greyish appearance.

Hab. Travancore. B.M.

British Museum,
May 18, 1881.

XLVIII.—*On some* Buprestidæ *from Australia.*

By Charles O. Waterhouse.

Buprestidæ.

Chalcotænia vittata, n. sp.

Valde elongata, postice attenuata, ænea, supra fere nigra, nitida; thorace antice parum angustato, guttis parvis punctulatis viridi-aureis impresso, disco plaga lanceolata notato; elytris costis quatuor perparum elevatis, interstitiis guttarum auratarum seriebus notatis, marginibus vitta lata impressis.

Long. 18-21 lin.

Closely allied to *C. ajax*, Saund., but much narrower, more attenuated posteriorly, nearly black above, and with a golden-green submarginal stripe on the elytra extending from the shoulder to the apex. The thorax is of the same form as that of *C. ajax*, but with the posterior angles not the least prominent; there is no impression within the posterior angles, the surface being gently convex, with small dots or irregular green marks scattered here and there, leaving the greater part black; in the middle of the disk is a narrow lanceolate space more or less defined by some green punctured lines. The elytra are evenly convex, smooth, with the suture slightly raised; each elytron has four scarcely noticeable costæ, marked out by lines of fine punctures; the first, second, and third intervals have each a series of small golden-green more or less elongate marks; in the second interstice there are generally two marks which are larger than the others; the sutural angle has a very small tooth; and there are three or four small teeth on the apical margin. The underside of the insect is green, with golden reflections. The punctures on the prosternal process have a tendency to form a line in the middle. The metasternum has a few strong punctures. The abdomen has numerous impressions filled with pale yellowish pile, one at the side of each segment being particularly conspicuous. The male has the fifth segment deeply triangular, notched at its apex; the sixth segment has all its apical portion concave and filled with yellowish pile or cottony substance. The female has the fifth segment slightly truncate at the extreme apex, with an elongate triangular apical impression, which is filled with yellowish pile; the sixth segment is not visible.

Hab. Queensland.

Chalcotænia læta, n. sp.

Ænea, subtus viridi-aurea; thoracis disco nigro-cæruleo laxe punctulato, linea mediana viridi, lateribus rugosis aureis; elytrorum sutura apiceque cyaneis, costis fere nigris, interstitiis viridibus, regione humorali aurata, macula sub humero, altera discoidali rotundata ante medium, altera elongata obliqua (medio gutta elevata nitida) ante apicem læte cupreis, impressis; femoribus anticis medio lævibus.

Long. 9–13 lin.

This species is so close to *C. australasiæ*, Saund. (Tr. Ent. Soc. 1872, p. 248, pl. vi. fig. 6), that I formerly considered it a variety of that species. Having now several specimens, I am sure that it is distinct. The most noticeable character is the oblique coppery impression near the apex of the elytra, which is more conspicuous than in *C. australasiæ* and cuts off the apex of the second costa, thus preventing its uniting at its apex with the first costa; besides this, the third costa is more abbreviated, a fragment of it, however, appearing before the middle of the impression. The shoulders are more golden, the costæ being interrupted there. The thorax has the line of demarcation between the rugose sides and the comparatively smooth disk more clearly defined. The underside of the insect is less golden, less densely punctured; the abdomen has more smooth space; the inner margin of the metathoracic epipleura is more or less smooth; but particularly the anterior femora are smooth or very nearly so in their middle, instead of being closely punctured all over.

Stigmodera Macfarlani, n. sp.

Thorace purpureo, cupreo micante, lateribus flavis, scutello viridi; elytris flavis, ad basin angustissime æneo marginatis, fasciis duabus latis apiceque cyaneis, corpore subtus viridi flavo ornato.

Long. 15–17 lin.

Near *S. Spencei*, Gory, but with yellow sides to the thorax; of the same form, but with the thorax a trifle more narrowed in front. Head yellowish green, tinted with coppery, closely and finely punctured. Thorax distinctly and moderately closely and evenly punctured; purple or coppery red (according to the position in which it is seen), with the sides broadly yellow; the extreme base at the sides is bordered with coppery. Elytra deep yellow, moderately strongly and evenly punctate-striate; there is a dark blue spot below the shoulder, and a transverse band across the suture (this band and the spot below the shoulder are united in the second example, and form one band); there is a very broad band behind the middle, with its posterior margin flexuous; and the apex is also dark blue, the upper margin of the blue colour flexuous; the apex is broadly truncated, the truncature flexuous, the outer angle with a small tooth. The underside is green, with the flanks of the prothorax, a spot or two on the sterna and epipleura, a band on the posterior coxæ, and a transverse band in the middle of each abdominal segment yellow. Prosternal process smooth.

Hab. Torres Straits, Murray Island, and Cornwallis Island. Two examples received from the Rev. J. S. Macfarlane.

Stigmodera viridicincta.

Stigmodera viridicincta, Waterhouse, Tr. Ent. Soc. 1874, p. 543.

Three examples of this species were received with the above described. They agree in general coloration with the "variety" which I described, having the sides of the thorax deep red; the elytra yellow, with the sides and apex red; but in addition to the green at the suture and extreme apex of the elytra there is a transverse spot across the suture rather behind the middle, one of the specimens having another green spot on the disk of the elytron, which is really only a disconnected part of the transverse spot or band across the suture. This last specimen has also the red at the sides of the thorax united by a red band near the base; so that the whole thorax is red, except a large spot in front and the extreme base, which are green.

Stigmodera sexmaculata.

Stigmodera sexmaculata, Saunders, Journ. Linn. Soc. ix. p. 465, pl. ix. fig. 13.

An example of this species just received has the elytra entirely deep yellow, except the apex, which is blue.

British Museum,
May 18th, 1881.

XLIX.—*Mr. Butler on Butterflies from Japan.*
By H. J. Elwes, F.L.S.

On my return from India my attention was called to a by Mr. Butler in the Ann. & Mag. Nat. Hist., Feb. p. 132, which seems to call for some reply on my part.

In a paper on the genus *Colias* by me in Trans. Ent. Soc. for October 1880, p. 133, I criticised his determination of some specimens of this genus from Japan, which, though not then published, were indicated as distinct species in the British-Museum collection, and have since been described by him. Mr. Butler seems to think it great presumption on my part to criticise his determination of species, and hints that my rash enthusiasm to do some work in a branch of natural history which is comparatively new to me has led me to write in haste what I shall repent at leisure.

Now, though I readily agree with him that, in order to avoid controversy, it would be better that his species should be examined by an entomologist of longer experience than myself, I do not at all repent what I have written, though, in the matter of the Candahar *Colias*, I must apologize for having used the word described when I should have said admitted. The *lapsus calami* must have been apparent from my quoting the authorities for the names. The fact is that at the time my paper was read Mr. Butler's paper (see P. Z. S. 1880, p. 403) was not yet published, and I had only seen a proof of it; but this slip does not alter the case materially, as I hold that a naturalist who admits species without question that have been previously described by others as varieties or aberrations only, as in the case of *C. sareptensis* and *C. pallida*, is responsible for their specific value.

To show how far my views of this question coincide with those of other naturalists, I may cite one recent case in which Mr. Butler's work has been tested by others; and here, at any rate, it cannot be said that it has been done by inexperienced or hasty workers. Messrs. Godman and Salvin, in 'Biologia Centrali-Americana' (see "Lepidoptera," p. 73), in dealing with those species of the genus *Euptychia* which occur within their limits, have carefully examined their unrivalled collection. The genus having been twice reviewed by Mr. Butler (see P. Z. S. 1866, p. 459, and Journ. Linn. Soc. Zool. xiii. 1876, p. 116), must be considered as one in which his matured views as to specific distinction are shown; and what is the result? Why, that forty-six supposed species and two named varieties of *Euptychia* (for a few of which, however, Mr. Butler is only partly responsible, though he has adopted them) are reduced to thirty; and in the case of *E. camerta*, Cr., which had been divided into five species, the following remark is made:—"We find it quite impossible to follow Mr. Butler and others in their minute subdivision of this species." See further on, p. 85, with regard to *E. polyphemus* *. Many similar cases could no doubt be found if it were worth while to search for them; but I do not suppose that any thing I can say will have the slightest effect in modifying his views.

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* "After a close examination we are unable to discover any differences by which to recognize Mr. Butler's three species as distinct from each other."

But I find that Mr. Butler can be very hard on others who do not happen to have the same opportunities as himself for special training and the same facilities for referring new and rare species to their correct genera.

I refer to his remarks in Ann. & Mag. Nat. Hist., March 1881, pp. 229 and 237, on M. Oberthür's memoir on the Lepidoptera of Askold, where, after going through his species critically, and correcting the nomenclature of most of them (which corrections will no doubt soon receive further corrections at the hands of some one else), he says that "it is impossible to overestimate the injury through waste of time which is occasioned to workers by the publication of duplicate names for the same species."

In this remark I most heartily concur with him; and though I shall not attempt to defend M. Oberthür from the charge of adding new synonyms to the list, yet it is, at any rate, easy to tell at once, by the beautiful figures in his liberally distributed 'Etudes,' what are the species to which his names refer; whilst I defy any one, even when descriptions of over a page length are given, as in the case of *Colias Elwesi*, to tell with or without figures what such species as that and *Colias pallens* really are, unless they see the types.

Since writing my paper I have carefully examined the species in question at the British Museum, and see no reason to alter my opinions respecting them—though, in the case of *C. subaurata*, I think that the colour of the underside in selected specimens may be enough to distinguish them. I repeat that it is most unlikely that in such a genus—by which I mean a genus of which most of the species are very wide-ranging and very variable, developing, under different conditions of life and in different climates, numerous slight local varieties and possibly hybrids—it is most unlikely that four species of one group (namely the *hyale* group, which, in the whole of the Nearctic and Palæarctic regions, has only four or five distinct species, from my point of view) should exist in Japan alone, or rather in that small part of Japan from which Mr. Maries's collection came. I said collections generally, but find that Mr. Butler includes in his list of species in this one collection four *Coliæ* of this group. I fully allow that the climatic conditions of the various islands in Japan are varied and likely to develop numerous variations, as is abundantly proved by the plants of Japan; but this seems to make my case the stronger.

It is no doubt very easy to get over the difficulty by saying that what I call varieties Mr. Butler calls distinct species, and in some cases, as I have heard, even distinct genera; but I affirm with confidence that if the butterflies of Europe were treated by Mr. Butler in the same way as the butterflies of Japan have been, the number of names, I will not say species, would be doubled, and perhaps trebled, supposing that he had a large-enough collection to work upon and no critics *.

If any one with a rich collection of European and North-Asiatic butterflies will take the trouble to examine the genus *Argynnis* closely, and test the validity of such species as *A. vorax*, Butl., *A. paphioïdes*, Butl., *A. rabdia*, *A. pallescens*, Butl., *A. locuples*, Butl., or to examine some of his new species of Japanese *Papilio* with a good series of specimens, I think it will be found that they do not bear the test much better than the *Coliæ*; and, considering that some of his Japanese species have been described from drawings, like *Pararge echinoides*, and others from single faded and worn specimens, like *C. pallens*, this is not surprising, though I believe there were sufficient specimens of the *Argynnes*.

It is quite possible, and even probable, that a more perfect knowledge of the distribution, seasonal forms, and metamorphoses of Japanese insects may prove the distinctness of some of these species; but I think it is better to wait till there are at least good reasons for describing them, than to run the risk of adding more to the already long list of useless and troublesome synonyms.

I will here take the opportunity of making remarks on some new species described by Mr. Butler in Ann. & Mag. Nat. Hist., Jan. 1881, p. 32.

Argynnis gemmata, Butl., is a very distinct and beautiful species—so much so, that I was astonished to find, when I compared my specimen at the British Museum last year, and pointed it out to Mr. Butler, that it had been overlooked for so many years.

With regard to the localities given, viz. "Darjeeling (*Lidderdale*); between Nepal and Tibet" (*Charlton*), I must say a few words. Though more definite than the abominable expression "Northern India," which was and still is so much in favour among those ignorant of the physical geography of the Himalayas, or careless of the great importance of definite localities particularly in that part of the world, they are still, in this case, misleading.

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* As an instance of what may be accomplished in this direction by a painstaking and observant naturalist, I would commend to his notice Jordan's 'Diagnoses Plantarum' (1864), in which fifty-three species are described and twenty figured, most, if not all, of which are considered by other botanists to be varieties of *Draba verna*.

Darjiling is the central station and only town in British Sikkim, and is about twenty miles in a direct line from the plains, at an elevation of 7000 feet. It is the centre to which all native collectors bring their specimens for disposal; and in this way most of the species found in British and Native Sikkim and the adjoining parts of Bhotan, Tibet, and Nepal, from the level of the plains up to 18,000 or 19,000 feet, are or will be labelled "Darjiling" (*cf.* Proc. Zool. Soc. 1859, pp. 251–253), though they may come from districts belonging to two perfectly distinct zoological regions including three subregions—the Mongolian, the Himalo-Chinese, and the Indian (*cf.* Elwes on the Geographical Distribution of Asiatic Birds, in P. Z. S. 1873, p. 657, and Hodgson, in Journ. As. Soc. Bengal, 1835). These divisions are most important, as, with some knowledge of their characteristics, many facts in distribution are easily explained which would otherwise be inexplicable. Dr. Lidderdale, so far as I am aware, never travelled in the interior of Sikkim, but, except one season at Buxa in Bhotan, spent his time at Darjiling and its immediate neighbourhood.

Argynnis gemmata is, with little doubt, a Palæarctic form most nearly allied to *A. pales*, and is an inhabitant of the higher, drier regions of the interior of Sikkim, near the Tibet frontier. I am nearly sure that I took it myself, in August 1870, near the Yakla Pass, at 13,000 feet elevation; but the specimen, with many more, was destroyed by damp. Two years ago I got it again from the late Mr. Mandelli, collected by a native in the same district; and, though it may straggle along the Chola range towards British Sikkim, I doubt its occurring below 10,000 feet. Its occurrence in North-east Kumaon, for so one must, I suppose, interpret the vague term "between Nepal and Tibet" (though that term would equally well apply to native Sikkim if one had any reason to suppose that Charlton had ever been there), would then be perfectly natural and even to be expected; for though, in the case of birds, plants, and butterflies, the species found in the middle zone of elevation in Sikkim are mostly either peculiar or represented in the north-west Himalaya by allied forms, yet the alpine species are very often identical. The general terms Tibet and Chinese Tartary, so often given by writers as localities for species, should not be used if possible. Tibet is a country of enormous extent, of which only the frontier in two or three spots has been visited by naturalists, though Prejvalsky has recently penetrated the north-east for some distance. Nine times out of ten what is meant by these words is Ladak—a truly Tibetan province in its physical features, but politically part of Kashmir.

If, as we may hope, future travellers are able to penetrate or send native collectors into other parts of Tibet, such as the Chumbi valley, bordering on Sikkim, or the frontier districts adjoining Upper Assam, the locality from whence specimens are brought should always be specified, and the bare term Himalayas or, still worse, Northern India (which may mean any thing from Calcutta to Suddya or Kashgar) abolished.

As regards the next species described by Mr. Butler, *Papilio nebulosus*, I cannot agree with him, believing it to be merely an aberration of *P. antiphates*, as, indeed, he suggests it may be.

I procured at Darjiling two specimens of this aberration, neither of which agrees exactly with the other or with Mr. Butler's specimen in its markings, though they have both the same character. The gentleman in whose collection they were, and who, I believe, got them in the same season as Dr. Lidderdale's specimen, agreed with Mr. Godman and myself in this determination; and though it certainly appears to mimic *P. euphrates*, I think there is every reason to believe it is not a good species. If, however, it is necessary to breed it from the egg of *P. antiphates* in order to prove this, I am afraid many years will elapse before the matter is cleared up.

L.—*Description of a new Species of Mole from China.*

By OLDFIELD THOMAS, F.Z.S., British Museum.

THE specimen here described was obtained near Pekin by the late Mr. Robert Swinhoe during the British expedition to that place in 1860. Shortly after its arrival in England it was mentioned by Dr. Gray[*] as a new species, but was not named or described. Later it was referred to by Mr. Swinhoe[†] under the belief that it was identical with a mole obtained by Père David in Mongolia, and described by Prof. A. Milne-Edwards in his 'Recherches pour servir à l'Histoire naturelle des Mammifères' as *Scaptochirus moschatus*[‡]. I propose to call the new species, on account of the comparative slenderness of its tail,

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[*] P. Z. S. 1861, p. 390.

[†] P. Z. S. 1870, pp. 450 and 620. (In the latter place Mr. Swinhoe quotes the name as *Scaptochirus Davidianus*, a term which has never been used by Prof. Milne-Edwards.)

[‡] Texte, p. 173, Atl. pl. 17 *a*.

Talpa leptura.

Fur, as usual, soft and velvety, with slate-coloured bases and shining coppery tips. Eyes apparently covered by the integument. Tail short and slender, barely half as long as the skull, thinly clothed with white hairs. Muzzle broad; teeth large and powerful. Dental formula as in *T. leucura*, Blyth*, viz. I. $\frac{3}{3}$, C. $\frac{1}{1}$, P.M. $\frac{4}{4}$, M. $\frac{3}{3}$ †. Third upper premolar very strong and trenchant, twice as large as in *T. leucura*. In the lower jaw the second and third premolars are equal in size, very small, pressed closely together, and placed with their long axes at right angles to the direction of the jaw, thus differing from *T. leucura*, in which they are placed nearly longitudinally; the fourth is well developed, about three times the size of the two preceding it. Molars with numerous well-developed sharp-pointed cusps.

Dimensions.

	inches.
Head and body (about)	5·0
Tail	0·6
Fore foot, length, with claws	0·85
" breadth	0·6
Hind foot, length	0·8
Skull, length	1·35
" greatest breadth	0·7
Palate, length	0·57
" breadth, including molars	0·43
Length of lower jaw	0·89

With regard to the affinities of this species, it would seem to be somewhat intermediate between *Scaptochirus moschatus* and *Talpa leucura*, possessing the same dental formula as the latter, while the shape both of the muzzle and of the teeth in section is exactly as in the former. The structure of the teeth of *Scaptochirus* would, however, appear to be somewhat different from what is found in *Talpa leptura*, as Prof. Milne-Edwards has kindly informed me that the peculiar flat character of the molars, described in the 'Recherches' from a single specimen, has been also found in two others which have since been received by the Paris Museum; so that this character is thus shown to be a constant one. It seems probable, however, that it will in the end be found unnecessary to retain *Scaptochirus* as a genus distinct from *Talpa*, since *T. leptura* has so exactly the same broad muzzle and stout powerful teeth, and the difference in the dental formula only consists of the absence of one of the two minute teeth following the canine-like first lower premolar.

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* J. A. S. B. xix. p. 215, pl. iv. fig. 1 (1850).

† By an unfortunate misprint in the dental formula, the premolars of *Scaptochirus moschatus* were described as being $\frac{3}{2}$ or $\frac{2}{1}$, according to the manner of determining the lower canine; but, as is clearly shown by the figure and description, these numbers, if the molars be counted as $\frac{4}{3}$, as is done by Prof. Milne-Edwards, ought to be $\frac{2}{1}$ or $\frac{3}{2}$ respectively. As, however, there appears to be no doubt that the formula for *Talpa*, with regard both to the incisors and molars, given by Prof. Owen (Odontography, i. p. 416, 1840) is correct, the true number of premolars possessed by *Scaptochirus* will be $\frac{3}{3}$.

The following are the four different dental formulæ found among the moles:—

Inc. $\frac{3}{3}$, C. $\frac{1}{1}$, P.M. $\frac{4}{4}$, M. $\frac{3}{3}$, $\times 2 = 44$. (*T. europæa, cæca, mizura*[*], &c.)
Inc. $\frac{3}{2}$[†], C. $\frac{1}{1}$, P.M. $\frac{4}{4}$, M. $\frac{3}{3}$, $\times 2 = 42$. (*T. wogura* and *insularis.*)
Inc. $\frac{3}{3}$, C. $\frac{1}{1}$, P.M. $\frac{3}{4}$, M. $\frac{3}{3}$, $\times 2 = 42$. (*T. leucura* and *leptura.*)
Inc. $\frac{3}{3}$, C. $\frac{1}{1}$, P.M. $\frac{3}{3}$, M. $\frac{3}{3}$, $\times 2 = 40$. (*S. moschatus.*)

LI.—*Remarks on a Pathogenic Schizophyte*[‡].

By Prof. H. J. DETMERS.

WHEN about two and a half years ago it became my duty to investigate the prevailing Swine-plague, the so-called Hog-cholera, I first endeavoured to ascertain the nature and the cause of that disease, and to accomplish my object made numerous post-mortem examinations, and paid special attention to the microscopic examinations of the blood and of the morbid products and morbid tissues. Although the microscope at my disposal at the beginning of my investigation was only a small No. viii. Hartnack stand with three Hartnack and Prazmowski objectives (a 1-inch, a $\frac{1}{4}$-inch, and a $\frac{1}{8}$-inch imm. and correctives), and consequently not a strictly first-class instrument, and in its performance by no means equal to the work of a Tolles or a Zeiss, I soon became convinced that the blood, the morbid products, and the morbid tissues of the diseased and dead animal invariably contained, while fresh and not tainted by putrefaction, a certain kind of Schizophytes or *Bacteria*. The same presented themselves in three different shapes, namely as small globular *Bacteria* or *Micrococci*, as *Zoöglœa*-masses or clusters, imbedded in or kept together by a viscous mass, and as little rods or filaments. I soon found that all three forms belong to the same organism, and represent only different stages of development. The first or globular form predominated in the blood, the second in the morbid tissues (for instance, in the diseased portions of the lungs and in the lymphatic glands), and the rods occurred in greatest numbers in such morbidly changed parts and morbid products (for instance, in the ulcerous tumours of the intestines) as are accessible to atmospheric air and other external influences.

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[*] Günth. P.Z.S. 1880, p. 441.

[†] Prof. Owen (Odont. i. p. 416, footnote) says, "In the *T. moogura*, Temm. (lege *wogura*), the inferior canine is absent." From the examination of several specimens of the Japanese mole it appears to me to be rather the third incisor which is absent, there being no space whatever, when the jaw is closed, between the hinder edge of the third lower tooth and the anterior edge of the upper canine; and, moreover, it is not set in the same line as the first two teeth, as the third incisor is in the other moles, but is placed somewhat internal to them, just as the canine is in the common species.

[‡] From 'Science,' May 7, 1881. Read before the State Microscopical Society of Illinois, April 8th, 1881.

The constant occurrence of these Schizophytes soon made it appear probable that their presence is not merely accidental, but that very likely the same are connected with, and characteristic of, the morbid process of the disease. To get at the facts was one of my principal endeavours. How far I have succeeded I leave to others to judge.

Careful and repeated macroscopic and microscopic examinations of the tissues, but especially of the lungs (which, by the way, are always more or less affected by the morbid process of Swine-plague), soon revealed the fact that the principal morbid changes are brought about in the following way:—The finer capillary blood-vessels become obstructed or plugged, the more fluid portions of the blood exude into the tissues (in the lungs principally, and at first into the lobules, and then into the interlobular connective tissue); some, and, particularly in young animals, not seldom a great many, of the finest capillaries rupture, and innumerable small extravasations of blood, visible to the naked eye as tiny red spots, are deposited in the tissue. In the skin, subcutaneous tissue, and intestinal membranes the process is essentially the same; but to follow it further would lead too far for the present. Let me therefore mention another fact. While the blood taken from a vein of a diseased or dead pig invariably contains a large number of spherical *Bacteria* or *Micrococci*, and very few and usually small *Zoöglœa*-masses, the diseased parts of the lungs, and especially the stagnant blood which oozes out of the capillaries if the diseased parts of the lungs are cut into small pieces, invariably contain, besides *Micrococci*, numerous and large *Zoöglœa*-masses, which are most of them much larger than the blood-corpuscles, and abundantly large enough to clog the finer capillaries. All this of course does not prove that the Schizophytes constitute the cause of the morbid process. I therefore resorted to experiments. Having found that any inoculation of a healthy pig with the fresh pulmonary exudations of a diseased or dead animal invariably produces the disease in from three to fifteen days, or, on an average, in six days, I concluded it might be ascertained in two different ways (in a negative and in a positive way) whether or not the Schizophytes constitute the cause of the morbid process. If it were possible to free the Schizophytes from every thing, and to transfer the same without any vehicle whatever from one animal to another, for instance, like a louse or an itch-mite, the question would be very soon answered. But as that cannot be done, I had to get at the facts in a more indirect way. I repeatedly charged two ounces of an innocent fluid, at first pure and fresh milk, then boiled milk, mutton-broth, afterwards water, and finally albumen, with one drop of the infectious pulmonary exudation containing an abundance of Schizophytes. In about three days the fluids thus charged (which, by the way, were kept at a suitable temperature) were found to be swarming with Schizophytes identical in appearance with those found in the pulmonary exudation; and every inoculation made with these fluids proved to be effective; but in most cases the attack produced was of a comparatively mild type. To go further into particulars would take too much time; I therefore have to refer for particulars to my reports to the Commissioners of Agriculture. One thing, however, I must state. The fluid transferred by each inoculation was less than half a drop; but this half drop contained innumerable Schizophytes, while, as far as could be ascertained by careful microscopic examinations, nothing else contained in the original exudation had multiplied. Consequently nobody, unless he believes in the power of Hahnemannian dilutions, will contradict me and say the effect of the inoculations is brought about, not by the Schizophytes, but by an unseen and unknown virus, or chemical something, the existence of which cannot be proved. I was, however, not satisfied with these positive results, and concluded to try also the negative way. Knowing that it is impossible to separate the Schizophytes from their vehicle, I tried to free the latter from the Schizophytes, and resorted to filtration. I filtrated the pulmonary exudations through half a dozen of the finest filtering-papers obtainable, but found my effort to be in vain; for the filtrate, although freed from the *Zoöglœa*- ------ and rod-shaped *Bacteria*, yet contained numerous *Micrococcus* forms. The filtrate was put in a vial with a tight-fitting glass stopper; and when examined three days later it contained a great many rod-shaped *Bacteria* and comparatively few *Micrococci*. I therefore filtered it again, with the same result, except that the *Micrococcus* forms were not so numerous after the second filtration as after the first. So I filtered the exudation three or four times, each time through from four to six filtering-papers, and at intervals of about three days, till I was finally not able to detect any *Micrococci* in the now limpid filtrate. Inoculations with this filtrate proved to be ineffective. At another time (in the following winter) I tried again to free pulmonary exudation from the Schizophytes by means of filtration, but did not succeed. The filtrate always after each filtration contained numerous *Micrococci*. Whether in this second attempt I did not hit the right time for my second and third filtrations (that is, a time at which most or all of the *Micrococci* had developed into rod-shaped Schizophytes or filaments), whether the temperature was too low (the first successful attempt was made in the summer) and therefore the development of the Schizophytes was irregular or retarded, whether my filtering-papers were not fine enough, or whether all these circumstances combined made the filtration a failure, I do not know. An inoculation made with this filtrate proved to be effective; but the disease produced was of a very mild character; at any rate the animal recovered.

If more proof is yet required that the Swine-plague Schizophytes and nothing else constitute the infectious principle of that disease (and it seems that the above facts, which have been published more fully in my reports to the Commissioner of Agriculture, are not deemed sufficient), the following facts, if not making it absolutely certain, will at any rate, especially if considered *in toto*, to a great extent corroborate the assertion that the Schizophytes have and must have a causal connexion with the morbid process.

1. It has been and can be everywhere observed, where Swine-plague is prevailing, that the infectious principle floating in the air is attracted and taken up by sores, wounds, and even scratches, but does not enter the animal organism through the whole skin and through perfectly healthy respiratory mucous membranes.

2. Antiseptics or medicines which are either directly poisonous to the lower forms of organic life or destructive to those conditions under which low forms of organic life thrive and develop, and, among those antiseptics, especially carbolic acid, iodine, hyposulphite of soda, benzoate of soda, thymol, &c., have proved to constitute almost sure prophylactics. As one of the conditions necessary to the development of Swine-plague *Bacteria*, it seems that a certain degree of animal heat has to be regarded. At any rate after and while the

animal heat of a pig is reduced, by a continued treatment with carbolic acid, from the normal (102° to 104° F.) to an abnormally low temperature (say 96° to 97° F.), every inoculation with fresh infectious material has so far proved to remain ineffective. Further, the various antiseptics which have proved to be good prophylactics are very dissimilar in their chemical affinities and actions; and their prophylactic effect cannot very well be explained if the infectious principle is a chemical agency, a virus, or a poison, but is explained if the same consists in something endowed with life and power of propagation.

3. If the morbid process, the morbid changes effected, particularly the exudations and extravasations of blood on the lungs and in the skin, and the qualitatively unchanged condition of the blood (that is, excepting such changes in its composition as are evidently the product or necessary consequence of the morbid changes) are taken into consideration, it becomes obvious that something which causes obstructions in the capillary system (embolism) must constitute the cause; and nothing whatever able to accomplish that result can be found, except the colonies or clusters of Schizophytes, the *Zoöglœa*-masses imbedded in a viscous substance, while, on the other hand, these *Zoöglœa*-masses are never absent in a case of Swine-plague.

If I am allowed to digress a little, it may be here mentioned that I am well aware of the fact that German and French investigators claim for certain, and it may be for all, kinds of pathogenic Schizophytes chemical actions or fermenting properties; and undoubtedly many of them, especially among those belonging to the genus *Bacillus* (I mention *B. anthracis*) and probably some others, do possess and exercise such properties and cause fermentation. As to the Swine-plague Schizophytes, I have not been able to observe any fermenting effect or chemical action, except such as necessarily results from depriving the animal organism of certain elements and material, appropriated by the Schizophytes, and necessary to their subsistence and propagation. All other morbid changes appear to be the consequence of the obstruction of the capillary system by the *Zoöglœa*-masses, and therefore are the product of a mechanical and not of a chemical agency.

4. The adversaries of the so-called "germ theory" of disease, well knowing that a perfect separation of the Schizophytes (*Micrococci*, *Bacteria*, or *Bacilli*, as the case may be) from their vehicles, the animal tissues and fluids, is impossible, demand absolute proof. If conclusions may be drawn

from analogy between diseases of animals and plants, Prof. T. J. Burrill[*], of the Illinois Industrial University, more favoured by the nature of the objects of his investigation (apple-trees, pear-trees, and peach-trees), has furnished evidence, amounting to almost absolute proof, that the so-called blight of apple-trees and pear-trees and the so-called "yellows" of peaches are caused by Schizophytes similar in size (but otherwise not identical) to those which I consider as constituting the cause and infectious principle of Swine-plague, as will be seen by consulting the transactions of the meeting of the American Association for the Advancement of Science in Boston, 1880.

5. If the infectious principle were a chemical poison or virus, its action, one would suppose, would under all circumstances be exactly the same, and the malignancy of the morbid process and the time required for its development (the so-called period of incubation, or, more correctly, stage of colonization) would not be subject to changes dependent upon the season of the year, upon the individuality and temperature of the animal, and upon other yet unknown external influences, as is undoubtedly the case. An organic poison or virus, one would suppose, would act somewhat like the virus of a poisonous snake. In the same localities, in the same places, or the same yards and pens, and among the same breeds of hogs, in which the disease was exceedingly malignant in 1878, it was, as a rule, much milder in 1879, and still milder in 1880. As such are unmistakable facts, repeatedly and everywhere observed, it must be concluded that nothing but what is able to undergo changes, is subject to growth and development, and acquires vigour and propagates rapidly under favourable, but is weakened and multiplies slowly under unfavourable circumstances (in other words, nothing but what is corporeal and endowed with life), can constitute the cause.

6. If the cause and infectious principle of Swine-plague were a chemical poison or virus, one would suppose a cessation of the morbid process would be impossible, and an animal would never recover while its organism contains an abundance of the infectious principle in an effective condition—as is undoubtedly the case, because convalescents and animals nearly recovered frequently communicate the disease, even in a fatal form, to other healthy pigs; further, the fact that an animal once recovered possesses but little predisposition for future infection, or is seldom attacked a second time even if ever so much exposed, and then only contracts the disease in a comparatively mild form, could never be explained. But the whole

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[*] 'Science,' vol. i. pp. 162, 191.

presents an entirely different aspect, and admits explanation, if low and minute forms of organic life, such as the Schizophytes of Swine-plague, which, by developing and multiplying, finally destroy or exhaust in an animal organism the conditions necessary to future development and propagation, constitute the cause and the infectious principle (*cf.* an article entitled "The Destruction of Germs," in 'Popular Science Monthly,' communicated in extract in R. Hitchcock's 'Microscopical Journal,' Nov. 1880).

7. If some part or organ of a pig infected with Swine-plague happens to be in a state of congestion, such a part invariably attracts the infectious principle, and becomes a prominent, if not the principal, seat of the morbid process—a fact difficult of explanation, unless the infectious principle is something solid or corporeal.

8. The adversaries of the so-called "germ theory," as they are pleased to call it, demand absolute proof of those who claim that certain infectious diseases owe their origin or existence and spreading to very minute forms of organic life. They cannot deny that these forms exist, can be found, and have been shown; but they forget to show their virus, poison, fluidum, or chemical something. Does the latter exist only in their imagination? If the adversaries of the so-called "germ theory" demand absolute proof on our side of the question, let them set a good example and furnish it on their side, or only produce their virus, fluidum, or whatever it may be, and we will gracefully acknowledge that we are mistaken and have laboured in vain.

9. With the very best objectives ever made, and a fair ability to handle the microscope, I have never been able to find any thing identical with the Swine-plague Schizophytes in the blood and tissues of other healthy animals. When I commenced my investigation, the best objective at my disposal was a very fair 1-9 four-system immersion-lens of Hartnack and Prazmowski; but I soon found it be insufficient, and procured a 1-16 immersion of the same makers. This, too, after a while, did not give satisfaction, and I received a 1-12 (nominally 1-10) glycerine immersion of R. B. Tolles, which that renowned maker afterwards exchanged for a duplex 1-10 homogeneous immersion. This latter objective proved to be a very superior lens, and gave me glimpses of things of which I desired to see a little more—it showed flagella on *Bacillus subtilis*, which I had never seen with any of the other objectives; and so I thought, with a higher power, and a still more perfectly corrected lens, if a more perfect correction could be made, I might be able to see more plainly

the distinguishing forms and characteristics of the Swine-plague Schizophytes, and also learn a little more about their mode and manner of propagation. I therefore asked Mr. Tolles to make me a higher-power objective especially adapted to my work; and he has furnished me a duplex 1-15 homogeneous immersion objective (in reality a little more than a 1-16), which is, beyond comparison, the best objective I have ever seen. It is even superior, in definition and flatness of field, to a magnificent 1-18 homogeneous immersion objective (in reality a 1-20) of Carl Zeiss, made to order a month or two ago.

As to a proper generic place and name of these Swine-plague Schizophytes, I am at a loss. The best authorities (Cohn, Klebs, and others) who have attempted a classification are somewhat undecided themselves, and do not agree where generic lines ought to be drawn. At any rate the Swine-plague Schizophytes do not fit into any of the genera proposed. They are not *Bacteria*, because the single cells are spherical and not oblong; they can hardly be considered as *Micrococci*, because the same are bispherical in their advanced stage of development; and they cannot be classed among the *Bacilli* on account of their forming *Zoöglœa*-masses. I have therefore preferred to use, for the present, that name which, without any serious contradiction, is given by modern investigators to the whole family, Schizophytæ or Schizophytes, or the older name introduced by Nägeli, Schizomycetes.

The Swine-plague Schizophytes present themselves, according to their stage of development, in three different forms and shapes. Their simplest form, it seems, is that of a *Micrococcus*, or of a small globule of about 0·7 or 0·8 microm. ($\frac{1}{33500}$ inch) in diameter. It occurs invariably in the blood, the morbid products, and exudations, &c. of the diseased animals, and is never absent, but can always be found, though in some cases in much greater numbers than in others. The second form is bispherical, the spherical cell having duplicated itself by a gradual contraction in the middle, while growing endwise. These bispherical Schizophytes are always more or less numerous, and are motile, or move about, provided the temperature of their vehicle (lung-exudation or blood-serum, for instance) is not too low. Some of them, but probably only those which are separated from a larger chain, as will presently be explained, are provided, at any rate at one end, with a flagellum (a postflagellum), which, however, is so exceedingly fine that it can be seen only with the very best high-power objectives, like a Tolles 1-15, and the most favourable light obtainable, and even then only while the Schizophyte is slowly moving. I have never yet been able to see it while the Schizophyte was at rest.

These double *Micrococci*, or bispherical Schizophytes, soon undergo further development. Each single cell soon again contracts in the middle while growing endwise, and at the same time separates more and more, and becomes partially independent of its sister cell, with which, however, it remains connected for some time, even after it has completed its duplication. Meanwhile the sister cell, too, has become bispherical, and what a short while ago was a simple bispherical cell, has become a double bispherical body, resembling a small chain of four round joints. But the duplication does not stop; each of the four single cells, within a short time, doubles again; and soon quite a little rod or filament will be formed, which, on close inspection, presents a string or chain of bispherical cells, loosely connected endwise with each other. Under moderately high powers (say of 800 or 900 diameters) such a string represents a slender, rod-shaped moniliform *Bacterium*. While the single cells, or each half of each bispherical body, soon develop into double or spherical cells, the connexion between the latter gradually loosens, so that finally, if the temperature is not too low, and the development a rapid one (I have frequently observed that the number of bispherical cells in such a chain becomes doubled in less than five minutes), the chain breaks up into smaller ones (joints), each consisting of one or two bispherical Schizophytes, which, in separating from their neighbours, after some swinging to and fro, spin or draw out a very slender thread, a flagellum or cilium. But before all these changes (this rapid duplication) take place, the spherical *Micrococci*, when about to change to bispherical bodies, form those clusters (*Zoöglœa* or *Coccoglia* masses) which, being imbedded in, or kept together by, apparently viscous substance, obstruct the capillaries, and, according to my observations, constitute the principal and direct cause of the morbid process. In these *Zoöglœa*-masses the single *Micrococci*, it seems, undergo their first metamorphosis, or change to double bispherical cells; and this change continues till portions of the *Zoöglœa*-mass separate, or till finally the Coccoglia breaks and opens, when the bispherical bodies, and also some yet unchanged spherical *Micrococci*, become free. The former very soon commence their duplication; but as each new cell or globule soon produces another one and becomes bispherical, the same cannot be the source of the spherical bodies or *Micrococci*. The latter, it appears, have another origin, as will be presently explained.

In Swine-plague material, such as blood, blood-serum, lung-exudation, &c., if a day or two old, and sometimes while yet fresh, *Bacteria* of a peculiar shape and form make their appearance. The same are rod-shaped, and a trifle longer than a bispherical Schizophyte, or two united spherical bodies, but are not moniliform, and have at one end, or, in comparatively rare cases, towards the middle, a bright and light-refracting globule of much more density than the rest of the *Bacterium.* This globule is surrounded by a substance or an envelope of considerably less density, and is therefore less light-refracting. If that globule is situated at one end of the *Bacterium*, as is usually the case, the whole *Bacterium* presents the shape of a club, because the globule and its envelope have much more diameter than the rod. Billroth calls this form a *Helobacterium*, and the globule a resting spore (Dauerspore). Such a resting spore, according to Billroth and Cohn, at any rate if developed by a *Bacillus*, is able to resist very high degrees of heat and cold, and is very prolific, as it disseminates a large number of germs, which probably constitute the source of the globular *Bacteria* or *Micrococci.* As such *Helobacteria* are often found in perfectly fresh blood and exudations &c. (in the exudations most frequently) of hogs which are affected with or have died of Swine-plague, and are nearly always seen if the blood and exudations &c. are a few days old, it appears probable that the same not only constitute the source of the spherical *Bacteria* or *Micrococci*, but also that their great tenacity of life, or resistibility against adverse external influences, explains the ability of the infectious principle of Swine-plague to remain effective for a whole year, if protected, by clinging to or being imbedded in a moist and porous substance, such as an old straw stack &c.

Whether or not Swine-plague Schizophytes are able to multiply in any other form and manner than stated, I have not been able to observe. One observation, made already at the beginning, has found new and repeated confirmation, viz.:—Wherever or as soon as *Bacterium termo* makes its appearance in large numbers, the Swine-plague Schizophytes begin to disappear, and disappear in about the same ratio in which the former are increasing in numbers. In blood kept in a vial Swine-plague Schizophytes cannot be found when the blood begins to exhibit a purplish colour, or when the blood-corpuscles begin to decay or become destroyed. Further, the Swine-plague Schizophytes, although presenting the same general characteristics when cultivated in fluids foreign to the animal organism of a hog, show differences in so far as they present less uniformity in size, and as this development and multiplication proceed slower and with much less regularity. It seems the cultivated Schizophytes change and develop more slowly, and probably on that account are less vigorous in producing mischief; at any rate, an inoculation with cultivated Swine-plague Schizophytes, although effective in producing the disease, is always followed by a comparatively milder form of Swine-plague than an inoculation with material directly from the body of a diseased hog. This, however, does not involve that every inoculation with cultivated Schizophytes produces under all circumstances a milder form of Swine-plague than any natural infection; for such is not the case. The difference may be stated thus:—A natural infection, or an inoculation with material directly from the body of a diseased hog, as a rule, produces a malignant and dangerous attack, and as an exception a mild form of the disease—the frequency of the exception depending, it seems, to a great extent, upon the prevailing character of the plague; while an inoculation with the cultivated Schizophyte is, as a rule, followed by a mild attack, and, as an exception, or in rare cases only, by Swine-plague in its severest form.

Wherever Swine-plague is prevailing in its most malignant or fatal form, or, what is essentially the same, wherever formation of ulcerous tumours in the cæcum and colon is a frequent occurrence, where consequently an abundance of Swine-plague Schizophytes is discharged with the excrements of the diseased animals, there the spreading from animal to animal, and from herd to herd, is a rapid one; and *vice versâ*, wherever the spreading is rapid, there ulcerous tumours in the intestines are a frequent occurrence. In 1878 the same (the ulcerous tumours) could be found in about 75 per cent. of all cases that had a fatal termination, while at present (in Illinois) their occurrence is probably limited to about 5 per cent. of all cases.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 23, 1881.—Robert Etheridge, Esq., F.R.S.,
President, in the Chair.

The following communication was read:—

"On *Astroconia Granti*, a new Lyssakine Hexactinellid from the Silurian Formation of Canada." By Prof. W. J. Sollas, M.A., F.G.S.

This paper contained a description of a new fossil Hexactinellid sponge from the Niagara chert beds of Hamilton, Ontario. It is the second oldest known example of the Lyssakina. Some remarks were added on the mineral state of the spicules and their association with chert. The author proposed for it the name of *Astroconia Granti*, the former in allusion to the peculiarly spinose character of the rays of the sexradiate spicules. The anchoring spicules were described as consisting of a straight shaft with four recurved rays, each having a small bifid spine near the base on the outer surface.

In the discussion which followed

Prof. DUNCAN said it was interesting to see the modern Hexactinellids thus foreshadowed. Very lately he had seen one of the spicular forms described by Prof. Sollas in a form he had just described. He quite agreed with the author in assigning this form to the Lyssakine Hexactinellids. There could be no question as to the solution of sponge-spicules in sea-water, as he had lately seen evidence in specimens of deep-sea dredgings. The results of Mr. Maw's washing promised to be very interesting. He had examined many, but had not yet found either sponge-spicules or Foraminifera.

Prof. RUPERT JONES noticed that there are different kinds of "chert," and expressed his opinion that Mr. Sollas had well explained the origin and formation of the spicular strata which he had described on this and other occasions. He thought that Dr. Wallich's hypothesis of the conversion of extensive layers of sponge-protoplasm into black flint elucidated many, but not all, of the phenomena connected with the origin of such siliceous strata as flint and chert. He noticed that sponge-spicules, and numerous other Microzoa from the Upper Silurian shales of Shropshire, had been noticed lately by Mr. Smith of Kilwinning.

Dr. HICKS said that it was remarkable that chert was not associated with *Protospongia*, as, on either Dr. Wallich's or Prof. Sollas's view, might have been expected.

Prof. JUDD said that as the solution of siliceous organisms had been recently doubted, Prof. Sollas's observations were of additional interest. He himself fully believed that this solution did take place; now and then he had found, in examining the residues left by dissolving chalk in acid, the thickest portions of siliceous spicules still remaining not quite destroyed in chalk.

Prof. SOLLAS replied that he believed a spicule had been described by Mr. Carter similar to that mentioned by Prof. Duncan. The one described now by him was, however, much more robust. He had never been able to find spicules in the Wenlock. He really could not comprehend what Dr. Wallich's views really were. That none of the fossil siliceous spicules which the author had described were originally calcareous was quite certain. As for *Protospongia*, it did not occur in limestone, and bore a very small proportion to the mass of the bed; and this might account for the absence of the chert.

March 9, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Description of Parts of the Skeleton of an Anomodont Reptile (*Platypodosaurus robustus*, Ow.).—Part II. The Pelvis." By Prof. Owen, C.B., F.R.S., F.G.S., &c.

In this paper the author described the remains of the pelvis of *Platypodosaurus robustus* which have now been relieved from the matrix, including the sacrum, the right "os innominatum," and a great part of the left ilium. There are five sacral vertebræ, which the author believes to be the total number in *Platypodosaurus*. The neural canal of the last lumbar vertebra is 8 lines in diameter, and of the first sacral 9 lines, diminishing to 6 lines in the fifth, and indicating an expansion of the myelon in the sacral region, which is in accordance with the great development of the hind limbs. The sacral vertebræ increase in width to the third; the fourth has the widest centrum. This coalescence of the vertebræ justifies the consideration of the mass, as in Mammalia, as one bone or "sacrum," which may be regarded as approaching in shape that of the Megatherioid Mammals, although including fewer vertebræ. Its length is 7½ inches; its greatest breadth, at the third vertebra, 5½ inches. The ilium forms the anterior and dorsal walls of the acetabulum, the posterior and postero-ventral walls of which are formed by the ischium and pubis. The diameter of its outlet is 3 inches, the depth of the cavity 1½ inch; at its bottom is a fossa 1¼ inch broad. The foramen is subcircular, 1 inch in diameter. The ventral wall of the pelvic outlet is chiefly formed by the pubis; it is a plate of bone 6 inches broad, concave externally, convex towards the pelvic cavity. The subacetabular border is 7 8 lines thick: it shows no indication of a pectineal process, or of a prominence for the support of a marsupial bone. The author remarks that of all examples of pelvic structure in extinct Reptilia this departs furthest from any modification known in existing types, and makes the nearest approach to the Mammalian pelvis. This is shown especially by the number of sacral vertebræ and their breadth, by the breadth of the iliac bones, and by the extent of confluence of the expanded ischia and pubes.

2. "On the Order Theriodontia, with a Description of a new Genus and Species (*Ælurosaurus felinus*, Ow.). By Prof. Owen, C.B., F.R.S., F.G.S.

The new form of Theriodont reptile described by the author in this paper under the name of *Ælurosaurus felinus* is represented by a skull with the lower jaw, obtained by Mr. Thomas Bain from the Trias of Gough, in the Karoo district of South Africa. The post-orbital part is broken away. The animal is mononarial; the alveolar border of the upper jaw is slightly sinuous, concave above the incisors, convex above the canines and molars, and then straight to beneath the orbits. The alveolar border of the mandible is concealed by the overlapping teeth of the upper jaw; its symphysis is deep, slanting backward, and destitute of any trace of suture; the length of the mandible is $3\frac{1}{4}$ inches, which was probably the length of the skull. The incisors are $\frac{5-5}{5-5}$, and the molars probably $\frac{5-5}{5-5}$ or $\frac{6-6}{6-6}$, all more or less laniariform. The length of the exserted crown of the upper canine is 12 millim.; the root of the left upper canine was found to be twice this length, extending upwards and backwards, slightly expanded, and then a little narrowed to the open end of the pulp-cavity. There is no trace of a successional canine; but the condition of the pulp-cavity and petrified pulp would seem to indicate renewal of the working part of the canine by continuous growth. The author infers that the animal was monophyodont. *Ælurosaurus* was said to be most nearly allied to *Lycosaurus*; but its incisor formula is Dasyurine.

With regard to the characters of the Theriodontia the author remarked that we may now add to those given in his 'Catalogue of South African fossil Reptiles,' that the humerus is perforated by an entepicondylar foramen, and the dentition monophyodont.

April 27, 1881.—Robert Etheridge, Esq., F.R.S.,
President, in the Chair.

The following communication was read:—

"On Fossil Chilostomatous Bryozoa from the Yarra-Yarra, Victoria, Australia." By Arthur William Waters, Esq., F.G.S.

The author gave a descriptive list of seventy-two species of Bryozoa belonging to the suborder Chilostomata, from a lump of clay obtained by Mr. Allen from the neighbourhood of the Yarra-Yarra river. The specimens are fragmentary, but in excellent preservation. There are eight species of *Catenicella*, a genus unknown in the fossil state until quite recently, when Mr. Bracebridge Wilson described twelve fossil species, none of which are known living; two of the Yarra-Yarra species still live in the Australian seas; and one of these also occurs in the Geological Society's collection from Mount Gambier. Among the most interesting of all the specimens described by the author is a *Catenicella* consisting of long internodes, with a double row of cells in each internode. The short-headed *Catenicellæ* now living have probably been developed from forms with long internodes. *Microporella* is also well represented by some interesting forms, which make it necessary to widen the definition of the genus. A very interesting *Cellaria* with subglobular internodes explains the Cretaceous fossil called *Eschara aspasia* by d'Orbigny.

Of the Chilostomata found in this deposit thirty-nine are considered new, although this number may have to be reduced; nineteen are now found living; seven correspond with those from the fossiliferous beds of Orakei Bay, New Zealand, described by Stoliczka;

and twenty-three are found in the Mount Gambier formation. Of about thirty Cyclostomatous Bryozoa which occur in this deposit, at least seven are common to it and Orakei Bay. Besides the Bryozoa the author has obtained many other organisms from this clay, and especially a large number of Foraminifera, now in the hands of Prof. Karrer of Vienna. He estimates the total number of determinable species belonging to various classes at over 200.

In treating of his special subjects the author adopts the principles of classification laid down by Hincks, Smitt, and other recent writers on living Bryozoa, which he regards as preferable in themselves, and also as facilitating the comparison of fossil with recent forms.

BIBLIOGRAPHICAL NOTICE.

A Memoir on the Echinodermata of the Arctic Sea to the West of Greenland. By P. Martin Duncan, M.B. (Lond.), F.R.S., &c., and W. Percy Sladen, F.G.S., F.L.S., &c. With Six Plates. London: Van Voorst, 1881.

The value and importance of a carefully prepared monograph on a given group of a given zoological province was brought before the readers of this journal a month or two ago, when their attention was directed to Capt. Legge's work on the Birds of Ceylon. We have again to illustrate this point by a notice of the memoir on a very different group of animals and from a very different region, which Prof. Duncan and Mr. Sladen have been able, by the aid of the government-grant fund, to publish in a very handsome form.

Thirty species of Echinodermata are in all described, and careful figures of parts, or complete specimens of most of these, are to be found on the six large plates which make a not unimportant portion of the volume. All, we are informed, tell the same tale as to distribution, and speak to the existence of a circumpolar fauna; herein they corroborate the results to which all recent investigators into the details of Arctic distribution have been led, and which, we may point out, were, so long ago as 1861, well expressed by Sir Joseph Hooker, when he spoke of the Scandinavian flora as girdling the globe in the Arctic Circle. When, however, the authors add to this that there is no extension northwards from more temperate climates we cannot think that they mean to speak of an arctic circumpolar as distinguished from a boreal circumpolar region (in the sense in which these words are used by Prof. Ehlers); for of the species which they describe no less than nine* have been found further south than the sixtieth parallel, and seven others have been found in our own seas. An arctic area in a zoogeographical sense must, as Marenzeller has pointed out, embrace all points which come in contact with the Polar stream.

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* Or ten, if the *Ophioglypha Tenorii* of Heller (Adriatic) be, as Mr. Lyman thinks, synonymous with *O. robusta*.

While on the subject of distribution we cannot but draw attention to another example of the resemblance between the Arctic and Antarctic faunas. In his lately published 'Preliminary List' Mr. Lyman gives as one of the localities for a species described in this monograph (*Ophiocten sericeum*) the rarely visited Marion Island.

Of the species described one only (*Antedon prolixa*) is absolutely new; but of the rest, one Ophiurid and one Asterid were first described by the authors of the present memoir in the pages of this journal, and from the very material on which their present work is based; while the time which has elapsed since their earliest determinations were published have, in both cases, enabled them to reconsider the generic appellations of the new forms. But, though the new species are comparatively inconspicuous, it does not by any means follow that the specimens which the authors have had in their hands have not required or received especial and careful study. In the first place, forms which extend over wide areas must exhibit a not inconsiderable range of variation, and forms widely distributed must be continually subjected to more or less insufficient descriptions at the hands of naturalists incompletely equipped for the work. This will become evident to any reader who will examine into the length and substance of the synonymical lists which Messrs. Duncan and Sladen have found it necessary to put out; some of these are so long that they not unnaturally bring before the mind the question of how far we might or might not be justified in accepting *in toto* the bibliographical data of our predecessors. With the abundance of the opportunities which are now afforded to all zoologists to write as much and at what length they please, it is obvious that if lists are prepared of every collection which makes its way into a museum, and if each of the quotations in these lists is to find its way into a synonymic list, the natural historian of a very early future will drag a chain of very considerable length; and the only possible relief will have to be found in taking the work of his predecessors not at their worth, but at a very high value.

We have been led by these considerations to institute a close comparison between one of the lists given by Messrs. Duncan and Sladen and that given for the same species (*Strongylocentrotus dröbachiensis*) by the naturalist whose fame is so largely associated with his work on the same group.

Far from finding that the one is the copy of the other, or that the work which the later writers have undertaken has been one of supererogation, we find something like half a score of differences between them—differences, we must say, which are, as a rule, to the credit of the later investigators; though such points as the omission of the page in the case of Gould, Desor, and Sars are comparatively trivial, Messrs. Duncan and Sladen's list has a greater comparative value from giving the information *, while more serious omissions on the part of Prof. Alex. Agassiz are to be found in the absence of any reference to the work of Gmelin, or to the important notice of Brandt (Midd. Sib. Reise, ii. p. 34), in which there occur the very striking words—"Sondern auch mit den von Mertens mitgebrachten Individuen eines Seeigels, worauf der *Echinus chlorocentrotus* des Prodromus basirt ist, der also künftig als Synonym des *neglectus* zu citiren sein wurde;" and which it is of interest to pit against the very opposite conclusion of Stimpson (a reference to whose 'Invertebrates of Grand Manan' is likewise omitted by Prof. Agassiz from his "synonymy")—"Among these are found several varieties, perhaps species, which an extended observation only can elucidate." Nor do Messrs. Duncan and Sladen follow the American writer in omitting a notice of Forbes's reference to the species in the Appendix to 'Sutherland's Journey,' where that gifted naturalist remarks on the fact that it is found in Pleistocene beds "associated with a molluscous fauna in many respects comparable with that of the Arctic seas."

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* Or, in the case of Fabricius, giving it more correctly.

We could carry this criticism further, but we gladly refrain: the lesson that it teaches us is not, however, a very satisfactory one; and if these things be done in the green tree, what shall be done in the dry*?

If a naturalist of first-class eminence afford material for such criticism, we may justly refuse to take on trust the work of those whose investigations have not attained, whether rightly or wrongly, the same vogue; but we feel bound to point out that, for the species under discussion, the only points open to criticism in Messrs. Duncan and Sladen's synonymy are those which we have thrown into the subjoined footnote. On the other hand, we cannot but regret that the present authors have thought it right to follow Muller and Troschel in the use of the term *Asteracanthion*, against the use of which Mr. Norman has already spoken in our pages, and that they have followed M. Perrier in returning to the quasi-specific names of Linck, whose work we are by no means behind the authors in regarding with the deepest respect. By speaking of *Astropecten corniculatus* Linck would indeed seem to be using the binominal method; but it is to be noted that his very next form is spoken of as *A. echinatus major*; and M. Perrier, by reviving the former of these terms, finds himself in opposition to every careful nomenclator since the time of Düben and Koren, who, in 1844, taught us to know this common form by Retzius's specific appellation of *crispatus*—a term we would, with deference, ask to be allowed to retain.

We greatly regret that we have been led to devote so much of our space to the mere question of nomenclature, and most sincerely wish it might have been otherwise. We have heard of men silenced by a "magni nominis umbra;" zoologists will have to be careful lest, under the chilling shade of synonymy, they lose the power which they need in all its fulness to help them solve the more important problems which, from the sides of embryology, anatomy, and palæontology, are receiving, if not their solution, yet their due attention.

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* May we point out to Messrs. Duncan and Sladen that 1840, not 1841, is the date of Gould's 'Invertebrates of Massachusetts' (1st ed.), that the 'Forhandlinger' in which Sars describes *T. pallidus* bears the *date* of 1872, and that the full account of Prof. Lovén's invaluable 'Etudes' might well be referred to?

The influences of "environment" are carefully noted by our authors, who are led to think that, in some cases at any rate, "the exigencies of arctic existence have acted in retarding the progress of growth-characters and in the maintenance of the youthful or more simple form." Again, they direct attention to the variations which they have observed in the length of the spinelets of the paxillæ of *O. papposus*, pointing out that extreme shortness is probably the result of abrasion, and consequently depends on the nature of the locality. "Thus a starfish inhabiting the comparative calms of deep water would be subject to much less friction than one frequenting a littoral district or amongst pebbly shingle."

From the point of view of the zoological student we desire, if we may be allowed, to congratulate the authors on the conclusion of a work which will be to them a source of pardonable pride, and ourselves on a monograph which sufficiently proves that there are in England two naturalists, at any rate, to whom a valuable collection of Echinodermata may very safely be intrusted for description.

MISCELLANEOUS.

Discovery of a Fossil Bird in the Jurassic of Wyoming.

By O. C. Marsh.

The oldest birds hitherto known from American strata are the toothed forms (*Odontornithes*), from the Middle Cretaceous deposits on the eastern flanks of the Rocky Mountains. In Europe, three specimens of the genus *Archæopteryx* have been found in the Jurassic, but from other formations no remains of this class have been brought to light. The writer has made a careful search for fossil birds in the Jurassic beds of the West, and has been rewarded by the discovery of various remains, some of which are sufficiently characteristic for determination. The most important of these specimens is described below.

Laopteryx priscus, gen. et sp. nov.

The type specimen of the present species is the posterior portion of the skull, which indicates a bird rather larger than a blue heron (*Ardea herodias*). The brain-case is so broken that its inner surface is disclosed; and in other respects the skull is distorted; but it shows characteristic features. The bones of the skull are pneumatic. The occipital condyle is sessile, hemispherical in form, flattened, and slightly grooved above. There is no trace of a posterior groove. The foramen magnum is nearly circular, and small in proportion to the condyle; its plane coincides with that of the occiput, which is slightly inclined forward. The bones around the foramen are firmly coossified; but the supraoccipital has separated somewhat from the squamosals and parietals. Other sutures are more or less open. On each side of the condyle, and somewhat below its lower margin, there is a deep rounded cavity, perforated by a pneumatic foramen.

The cavity for the reception of the head of the quadrate is oval in outline; and its longer axis, if continued backward, would touch the outer margin of the occipital condyle. This cavity indicates that the quadrate had an undivided head. The brain-case was comparatively small; but the hemispheres were well developed; they were separated above by a sharp mesial crest of bone. A low ridge divided the hemispheres from the optic lobes, which were prominent.

The following measurements indicate the size of the specimen:—

	millim.
Width of skull across occiput (approximate)....	24
Transverse diameter of occipital condyle	5
Vertical diameter	4
Width of foramen magnum	5
Height..................................	6
Distance from occipital condyle to top of supra-occipital	11

In its main features the present specimen resembles the skull of the Ratitæ more than that of any existing birds. Other parts of the skeleton will doubtless show still stronger reptilian characters.

In the matrix attached to this skull a single tooth was found, which most resembles the teeth of birds, especially those of *Ichthyornis*. It is probable that *Laopteryx* possessed teeth and also biconcave vertebræ.

The specimen here described, and others apparently of the same species, were found in the Upper Jurassic of Wyoming Territory, in the horizon of the *Atlantosaurus*-beds.

Yale College, New Haven, March 18, 1881.

Regeneration of lost Parts in the Squid (Loligo Pealei).

By A. E. Verrill.

I have observed in this species, as well as in *Ommastrephes illecebrosus*, numerous instances in which some of the suckers have been torn off and afterwards reproduced. In such examples new suckers of various sizes, from those that are very minute up to those that are but little smaller than the normal ones, can often be found scattered among the latter, on the same individual. It seems to me possible that some of the specimens having the suckers on the tentacular arms unusually small, may have reproduced all those suckers, or, still more likely, the entire arm.

I have seen specimens of this species, and also of *O. illecebrosus*, which, after having lost the tip, or even the distal half of one or more of the sessile arms, have more or less completely reproduced the lost parts. In such cases the restored portion is often more slender and has smaller suckers than the normal arms; and where the old part joins the new there is often an abrupt change in size. Probably this difference would wholly disappear after a longer time.

An unquestionable and most remarkable example of the reproduction of several entire arms occurs in a small specimen taken off Newport, R. I., Aug. 1880. This has the mantle 70 millim. long, dorsal arms 22 millim., third pair of arms 30 millim. The three upper pairs of arms are perfectly normal; but both the tentacular and both the ventral arms have evidently been entirely lost and then reproduced from the very base. These four arms are now nearly perfect in form, but are scarcely half their normal size on the left side, and still smaller on the right side. The left tentacular arm is only 24 millim. long, and very slender, but it has the normal proportion of club, and the suckers, though well formed, are diminutive, and those of the two median rows are scarcely larger than the lateral ones and delicately denticulated. The right tentacular arm is less than half as long (12 millim.), being of about the same length as the restored ventral one of the same side; it is also very slender, and its suckers very minute and soft, in four equal rows. The right ventral arm is only 14 millim. long, the left one 15 millim. long; both are provided with very small but otherwise normal suckers.

In another specimen from Vineyard Sound, a female, with the mantle about 150 millim. long, one of the tentacular arms had lost its club; but the wound had healed, and a new club was in process of formation. This new club is represented by a small tapering acute process, starting out obliquely from the stump and having a sigmoid curvature; its inner surface is covered with very minute suckers. The other arms are normal.

It seems probable that some of the normal European species of *Loligo* that have been based on the smaller size of the tentacular arms or of the suckers are due to similar instances of regeneration of these parts.—*Amer. Journ. Sci.*, April 1881.

Note on Wardichthys cyclosoma, *Traq.* By Thomas Stock, Natural-History Department, Museum of Science and Art, Edinburgh[*].

A small fish was described and figured by Dr. R. H. Traquair in the 'Annals' for April 1875, vol. xv. p. 262, pl. xvi. figs. 1–5, in a paper entitled "On some Fossil Fishes from the Neighbourhood of Edinburgh." The description was drawn up from a single specimen obtained by him from the Wardie Shales about fifteen years previously. A new genus was established for its reception under the name of *Wardichthys*, so called in honour of Mr. John Ward, F.G.S., of Longton, Staffordshire, a well-known collector of fossil fishes, and an author of repute in departments of geology and palæontology, and not with reference to the locality where it was found. The specific name *cyclosoma* was given in allusion to its nearly circular shape. The original specimen, though not entire, was very nearly so, being, however, deficient in the dentition and the tail. This interesting fish has remained unique until the present time. I am able, however, as a part of the good fortune which has attended my work upon the Wardie Shales, to announce the occurrence of a second specimen. It lay high upon the shore, apparently cast there by a lad. Like the original specimen, it occurs in a nodule, of which, however, only a fragment (and the less important fragment) has been recovered. A careful search was instituted for the remainder, but without success; and it is to be feared that the counterpart is irrecoverably lost. That an interval of about twenty years should have elapsed between the occurrence of the first and second examples shows that it is a fish of great rarity. Its rediscovery, however, holds out the hope that other specimens will be found if the bed (for it appears each time to have occurred in a particular bed of the Wardie series) be at intervals carefully searched.

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[*] Read before the Edinburgh Geological Society, April 1881.

The specimen here noted unfortunately throws very little additional light upon the structure of the fish. The dentition and the tail remain, as before, unknown. A portion of the flank with about ten series of scales is nearly all that has been preserved. The shape of the scales and their superficial ornament are very well shown in impression, the latter consisting of the characteristic tuberculation, which makes this an easily identifiable fish. The weathering action of the sea has been favourable to the disclosure of these characters. The configuration and sculpture of the scales are not often so well seen in fishes preserved in nodules. The chances are, when the nodule is violently fractured by the hammer and chisel, that the halves separate in such a way that only the undersides of the scales are visible. Sometimes the plane of fracture lies right through the scales; and it is difficult in such cases to get at their shape or sculpture by the employment of artificial aids. By the more gradual process of weathering the nodule almost invariably splits along the plane most favourable to the display of the superficial characters. The writer has succeeded in obtaining for his collection several fragments or entire specimens which have been preserved in this way. Where the weathering has proceeded far enough, as it has done in several cases, the ornament has been exquisitely brought out; and in several large fragments or entire specimens of *Rhadinichthys* and *Cosmoptychius* there is very little left in this respect to desire. From these natural moulds plaster casts may be easily obtained. Other specimens only await the application of acid to bring out their characters in an equally distinct fashion.

The possession of a plaster cast of the type specimen, due to the kindness of Dr. Traquair, places the accuracy of the generic identification beyond a doubt; and though the cast does not show the ornament quite so well as might be desired, the agreement in this character between my specimen and the original figures and description is such as to make the specific determination also a matter of certainty.

On the Anatomy of Pyrosoma. By M. L. Joliet.

Growth of the Colony.—All the observers who have paid attention to *Pyrosoma* have remarked that the closed extremity of the colony is occupied by four ascidiozoids. According to Savigny and Lesueur these are the four primitive individuals developed in the egg itself. As regards *Pyrosoma elegans*, in which, as stated by Keferstein and Ehlers, the endostyle is on the side of the common orifice, I cannot say how this may be; but in *Pyrosoma giganteum* things are different. Panceri has already remarked that the terminal ascidiozoids are destitute of those muscular cords which terminate at the periphery of the common cloacal aperture, and which are possessed by the primitive ascidiozoids. Moreover, in *P. giganteum*, as in *P. atlanticum*, the endostyle, and consequently the germinative point, are turned in the direction of the closed extremity. It follows that an animal placed at a given moment in the immediate vicinity of that extremity is necessarily separated therefrom some time afterwards by the three or four buds which it has directly produced, and, still later, not only by these but by their derivatives.

When we examine the closed extremities of several quite adult colonies, measuring several centimetres in length, we see that the four individuals forming the terminal whorl are in one specimen perfectly adult and beginning to breed, in another young and still furnished with an elæoblast, elsewhere, again, in the condition of simple buds, forming part of the stolon, and not yet detached from the parent. In a word, the terminal whorl of one colony does not resemble that of another colony of the same age, which would not be the case if this whorl were the primitive whorl. From these facts we see that if we desire to find the four primitive individuals, it is not at the closed extremity that we must seek for them, but at the open extremity. They are, in fact, incessantly pushed away from the former by the whole of their progeny.

Nervous System.—On the posterior median line there exists a nerve which traverses it throughout nearly its whole extent. It does not originate directly from the ganglion, but from a train of cells which seem to prolong the latter backwards, runs above the base of the languets, and appears to act upon a bundle of muscular fibres, which, passing behind the œsophagus, traverses the cloaca skirting the subintestinal peritoneal lamina.

In the four primitive ascidiozoids the two thick lateral posterior nerves terminate at the two muscular cords which start from the two sides of the œsophagus and run to the common cloaca. In the ordinary individuals there only exists one of these muscular cords; it is median, and morphologically represents the two cords of the primitive individuals; for it receives both the nerves.

Colonial Muscular System.—Besides the muscular cords just mentioned, there exist in the common transparent substance muscular bands which are by no means so well defined, and which unite the individuals to one another in the longitudinal direction. Panceri has described their course with considerable exactitude, but without knowing their origin. These muscular bundles originate in the transparent substance itself, in which we see them diverging at certain points; and they seem to be formed at the expense of the actual cells of this substance modified in a peculiar manner. The normal constituent cells of the common transparent substance are stellate.

On the Elæoblast.—Salensky has endeavoured to show that the elæoblast of the *Salpæ* may be the altered representative of the tail of the *Appendicularia* and the tadpole-larvæ of Ascidians. As regards *Pyrosoma*, this hypothesis is inadmissible. The elæoblast, in fact, acquires in *Pyrosoma* the form of a ring surrounding the germinative extremity of the endostyle. It is therefore no longer a simple organ as in the *Salpæ*. By its form and relations it cannot represent the tail of the *Appendicularia*.

Its function appears rather to be physiological. It enlarges so long as the bud remains attached to the parent, and diminishes from the moment when separation is effected, until that in which the young ascidiozoid, being brought into communication with the outer world, can live on its own account; it then disappears altogether. I do not think it plays any part, even a subsidiary one, in gemmation. In fact, it has completely disappeared at the period when gemmation has only just commenced. In all probability it acts as a reserve for the young animal at the time when its nutrition is still null or insufficient.

On the Alternation of Generations.—If we desire to bring together as much as possible what takes place in the *Salpæ* and what occurs in *Pyrosoma*, we must take as equivalent terms, on the one hand, the agamic *Salpa*, and, on the other, the Cyathozoid. We have then, in the two cases, two asexual individuals producing by gemmation a whole series of individuals which differ from them in form, are alike, and sexual. The whole difference then lies in the fact that, while the sexual *Salpæ* cannot bud, the sexual *Pyrosomata* are capable of producing by gemmation other individuals, but similar to themselves.—*Comptes Rendus*, April 25, 1881, p. 1013.

Investigation of certain Points in the Anatomy of Sternaspis scutata.—Second Note*. By M. Max. Rietsch.

The vascular system of *Sternaspis* is very complex and interesting; it may be summed up by saying that it includes a dorsal vessel and a ventral system.

The dorsal vessel follows the stomach, upon which it rests, in all its contours; it is much narrower behind than in front of the branchial anastomosis: this latter portion, which is at first wide, diminishes gradually to the commencement of the stomach; beyond this point it floats in the general cavity, but remains parallel to the œsophagus, to which it is attached by a few branches; finally it attaches itself to the pharynx, where it divides into numerous branches, the two principal ones forming a fork.

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* See 'Annals,' May 1881, p. 426.

The ventral vessel has numerous roots at the ventral surface of the pharynx and the anterior setæ; it travels parallel to the nervous cord, to which it sends several branches, and emits numerous branches to the segmental organs, which will be mentioned further on; then, towards the middle of the body, it gives origin (1) to a vessel which follows forward the posterior intestine, (2) to two other trunks, the most voluminous of which soon divides into three. Thus are formed the four sexual vessels, upon which the generative organs originate. Three of them run along different portions of the stomach, the fourth along the recurrent intestine: they give origin to very numerous branches, which divide repeatedly and generally dichotomously, and finally open into a sinus lodged beneath the muscular layer of the intestine and against the vibratile furrow. The latter, in the stomachal region, is diametrically opposite to the dorsal vessel, which communicates with this longitudinal sinus by a very complex system of capillary canals, destitute of proper membrane, and placed between the muscular layer and the epithelium. The whole intestine is thus furnished with a very rich system of blood-sinuses, communicating with both the dorsal vessel and the ventral vessel along the pharynx, œsophagus, and stomach, but having direct connexion with the ventral vessel alone through all the rest of the intestine; there are, however, vascular anastomoses between the different intestinal regions.

Further back the ventral vessel emits numerous symmetrical branches, which run to the integuments, the posterior setæ, and the terminal intestine; some of them terminate posteriorly at regular racemes of ampullæ or pyriform bodies with thin walls placed between the shield and the rectum, and evidently forming a reservoir for the blood when that fluid is driven backward by the invagination and contraction of the anterior region of the body. I have been unable to detect any communication between these racemes and the branchiæ. The circulation seems to me to be due principally to the general movements of the body.

The generative organs are of the same form in the two sexes. The external appendages are followed by two oviducts or spermducts, which run backward towards the median line, where they unite and at the same time adhere to the ventral vessel; each of them is accompanied by a sanguiferous branch, which is given off by this same ventral vessel, and which only quits them at the skin; from their point of convergence start the four lobes of the ovary or testis. These lobes are slowly formed along the four sexual vessels already mentioned; they possess each a *proper wall*, which is directly continuous with that of the oviducts, and in which the corresponding sexual vessel is enclosed. The ova originate upon the wall of this vessel, which is turned towards the interior of the ovary, and at the expense of the epithelial cells forming that wall, to which, at first, they remain attached by a peduncle; they afterwards become detached, descend along the lobe, and then arrive in the oviducts; thus they never fall into the general cavity. The sexual lobes are of very unequal length in the same animal, and unequally developed in different individuals according to the age; in *Sternaspides* of large size, especially in the males, they present short secondary lobes along the principal branches of the sexual vessel.

In front of the oviducts and involved in the folds of the œsophagus, there exist two voluminous segmental organs ("four-horned organs" of Müller), of a brown colour, with delicate walls, irregularly lobed, and each furnished with an excretory canal, which becomes much narrowed towards the integuments, and opens outwards by an extremely small pore. The two symmetrical pores are placed in front of the genital appendages. I have not yet succeeded in detecting vibratile funnels in connexion with these organs; they present an internal epithelium and an external peritoneal layer, and between the two a rich network of often capillary blood-sinuses.

Hitherto I have only been able to observe the first phases of the embryogeny as the result of artificial fecundations. The ova are about 0·15 millim. in diameter; within their chorion, which usually retains a trace of the pedicle, they present a granular vitelline mass with an eccentric nucleus and a nucleolus; this nucleus disappears in the mature ova. The spermatozoids are from 0·085 to 0·10 millim. in length; the head is elongated, and occupies about one sixth of the entire length. The segmentation is complete; it commences about five hours after fecundation. Even the first two spheres are unequal; and the difference becomes rapidly more accentuated between the small hyaline evolutive cells and the large, dark, granular nutritive cells; the former quickly envelop the latter, and thus form a planula by epibolism. In four-and-twenty hours I found in the glasses pelagic larvæ composed of an ectoderm with small elements, and an endoderm formed of a few large brownish spheres; they appear to be destitute of both mouth and anus. These larvæ are covered with vibratile cilia, except in the posterior region; at their cephalic pole they bear a plume of longer cilia. But the pelagic life hardly lasts longer than from thirty-six to forty hours; the larvæ fall to the bottom of the water, lose their cilia, become elongated, and assume a vermiform appearance and movements. The evolution is afterwards very slow in the glasses; at the end of a month the larvæ, although considerably more elongated, present a digestive tube formed of large cells and destitute of mouth and anus; its cavity is filled with a liquid which bears numerous granules, and which the movements of the body cause to travel from before backward or *vice versâ*; in the posterior region and on the dorsal (?) surface we may distinguish a small ectodermal appendage bent into a hook, which may be the first rudiment of the branchiæ.—*Comptes Rendus*, May 2, 1881, p. 1066.

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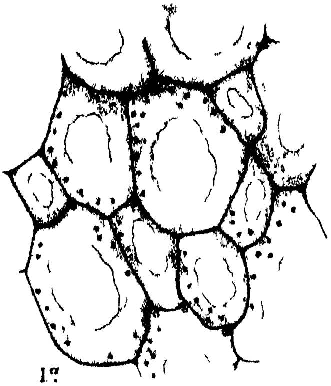

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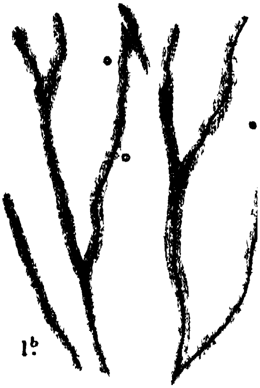

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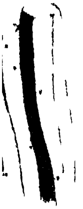

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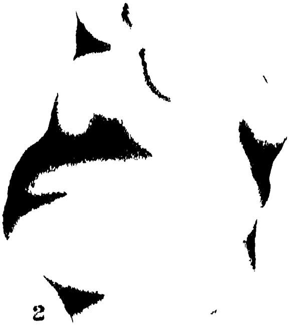

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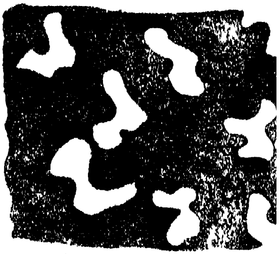

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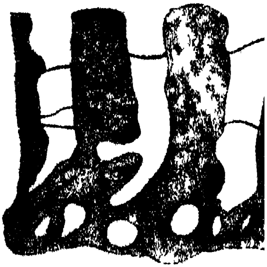

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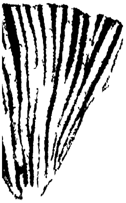

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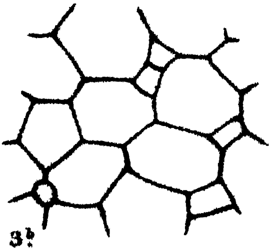

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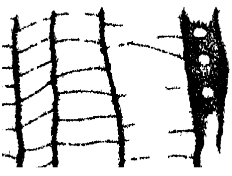

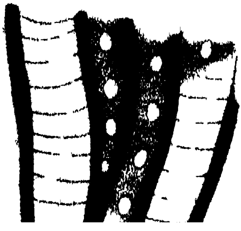

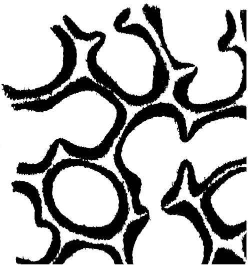

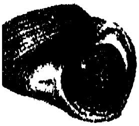
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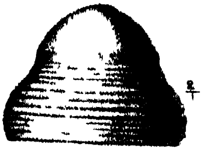
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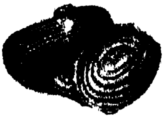
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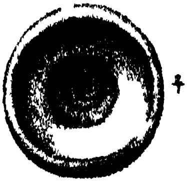
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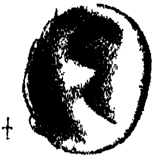
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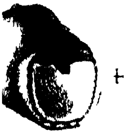
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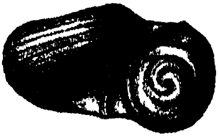
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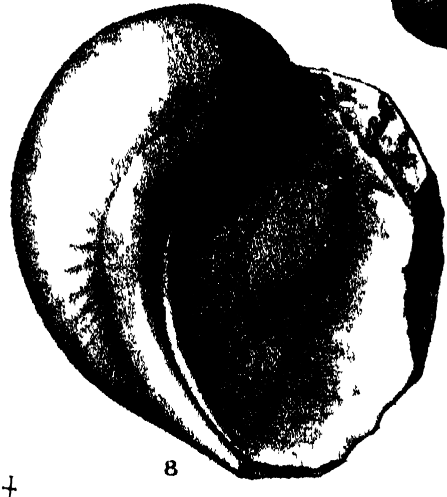
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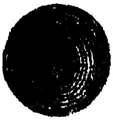
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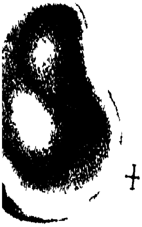
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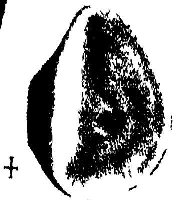
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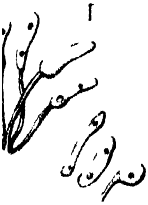
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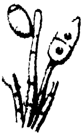
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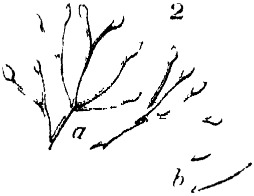
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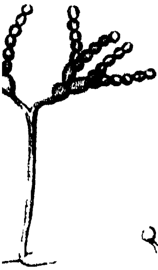

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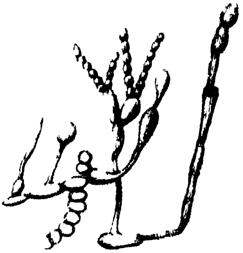

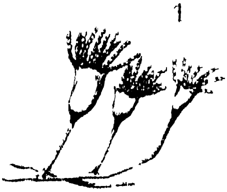
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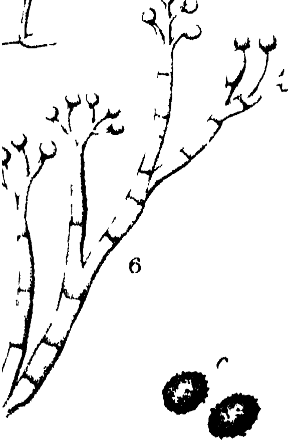
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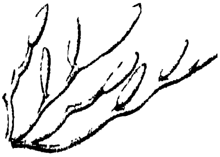
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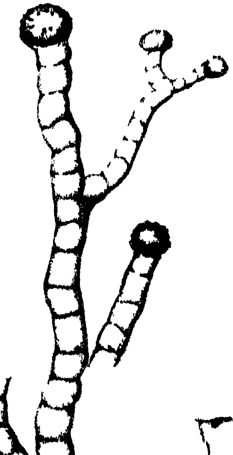

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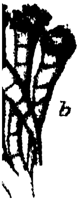

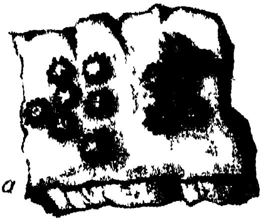

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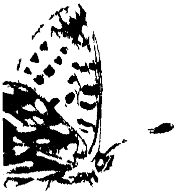

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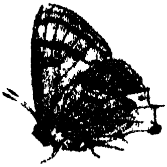

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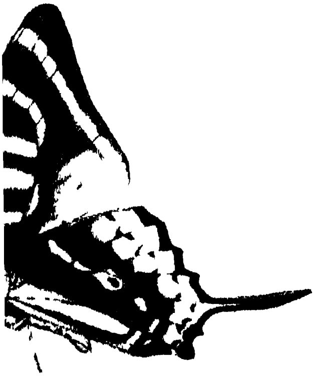

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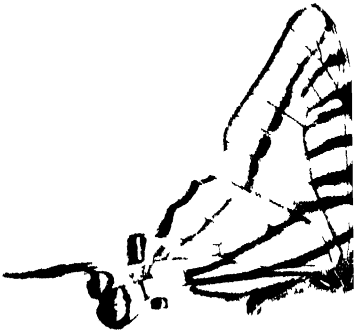

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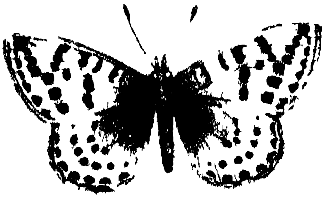

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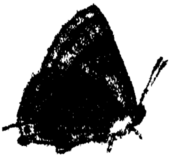

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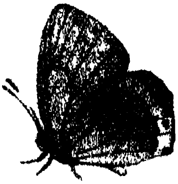

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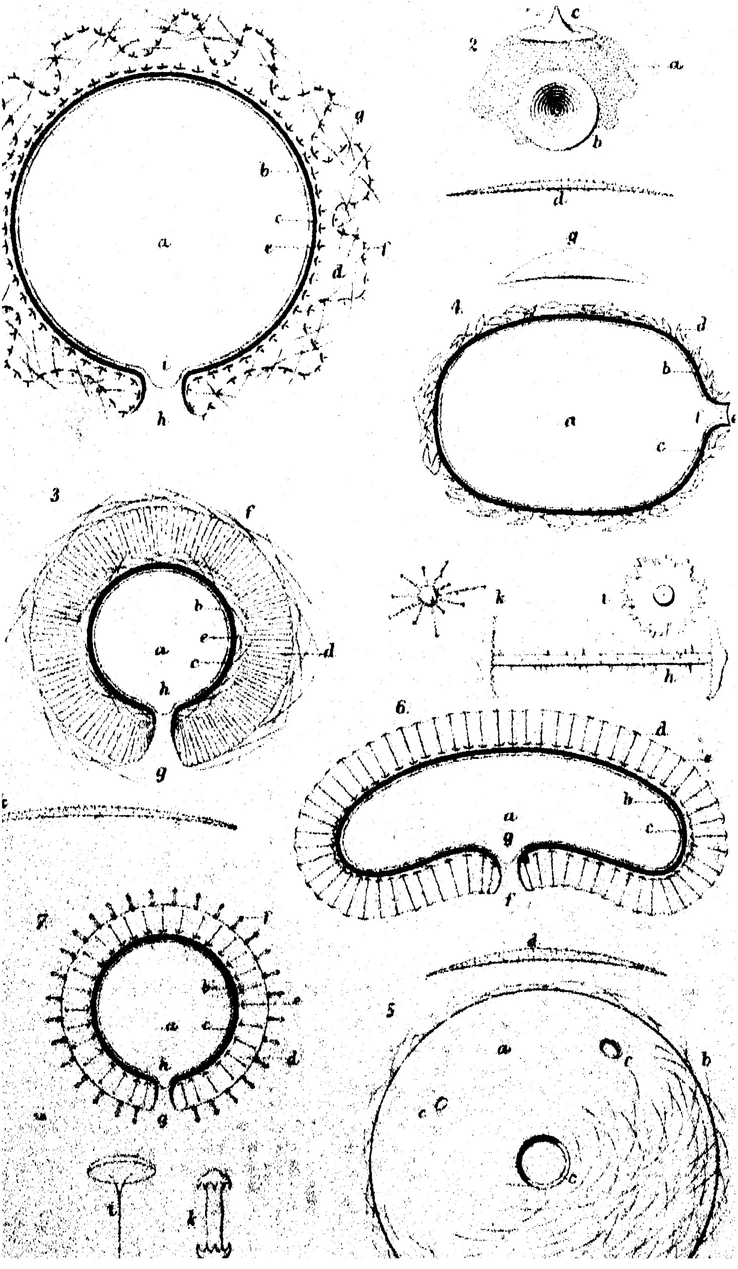
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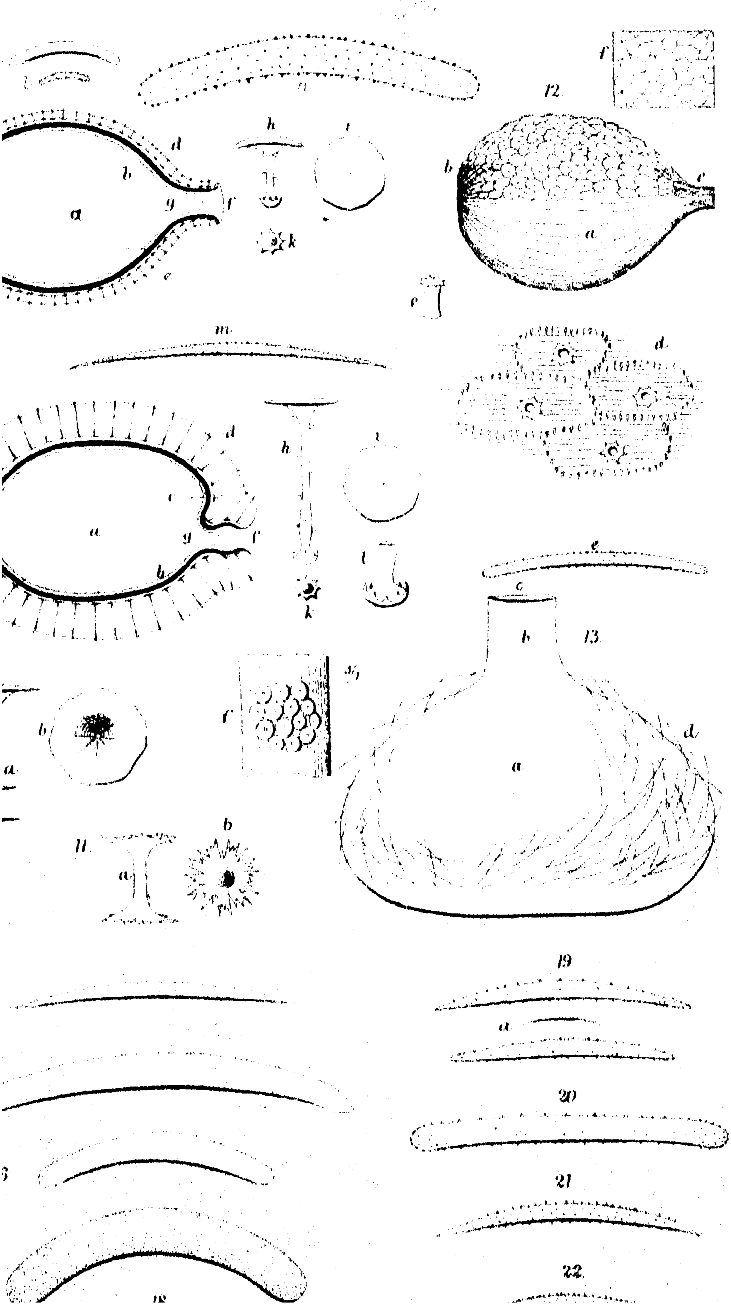
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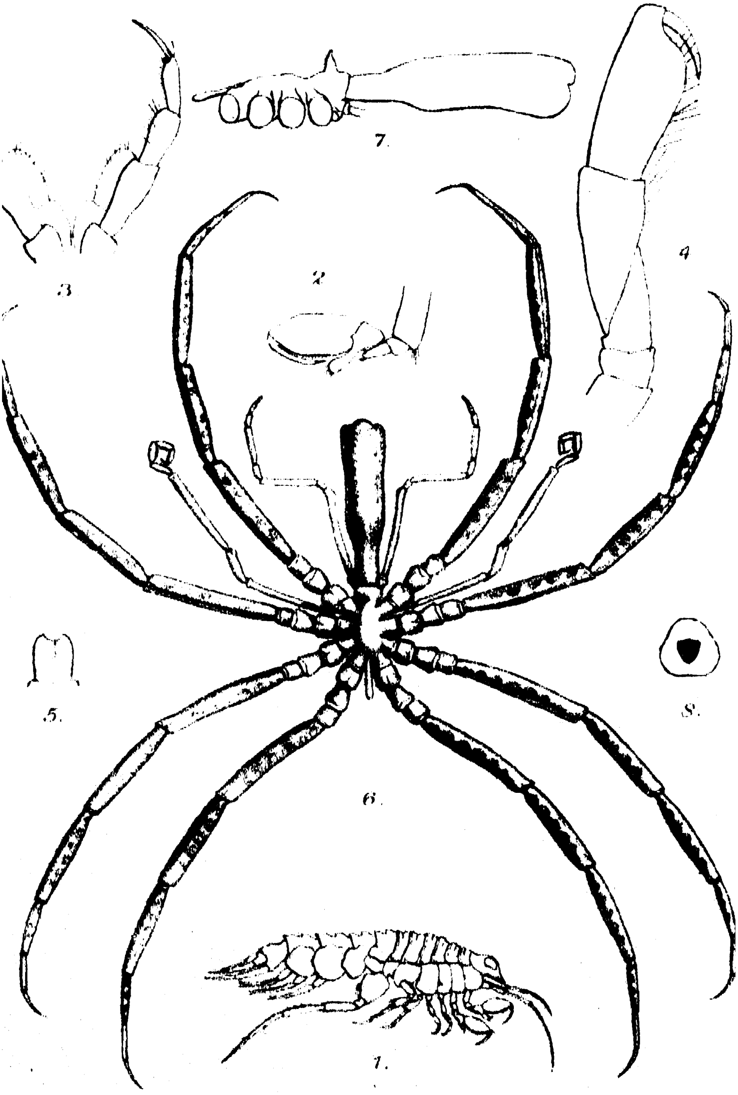
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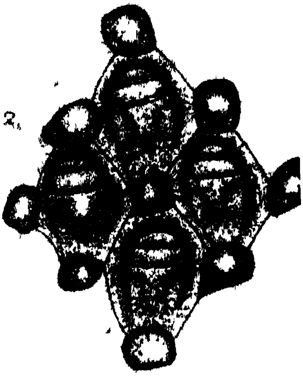
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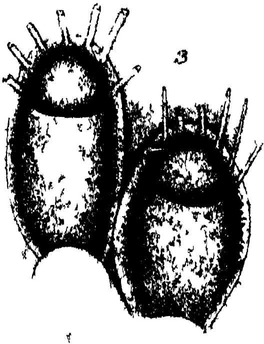
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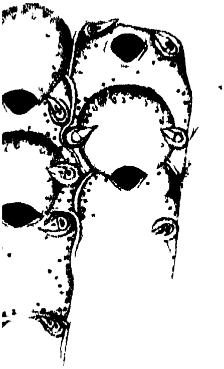

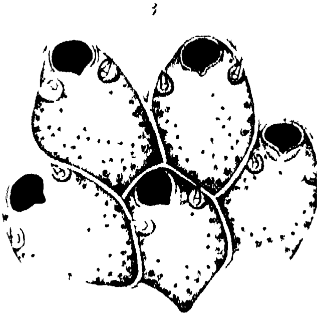
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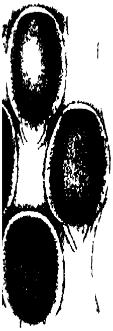

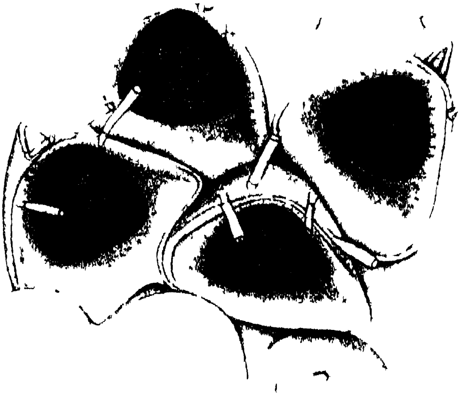

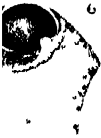
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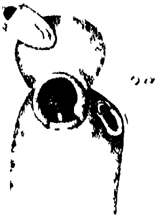
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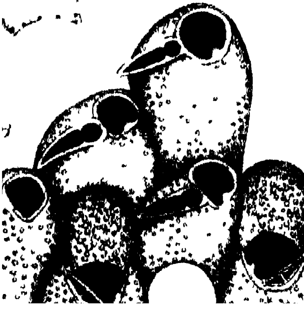

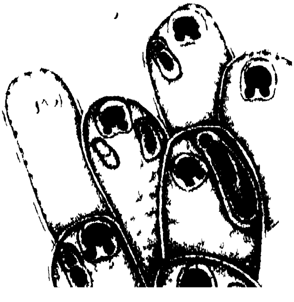

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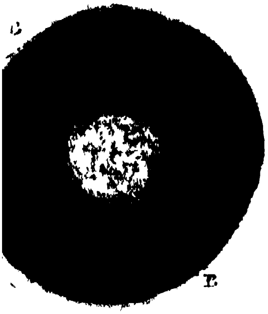

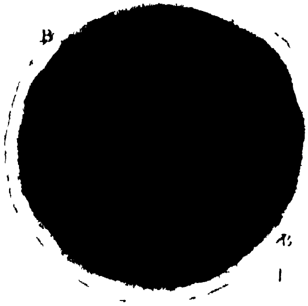

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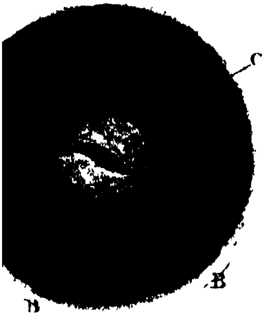

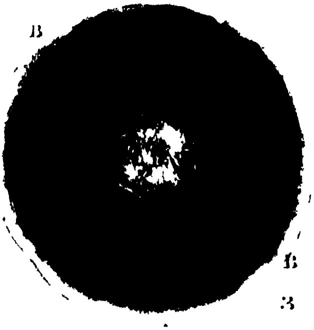

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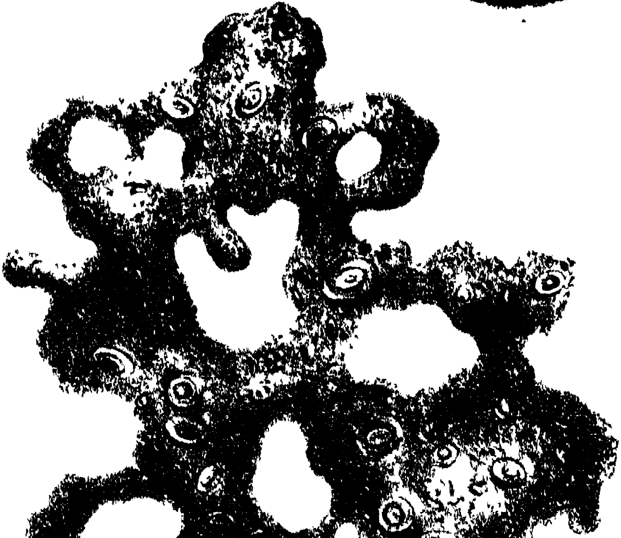

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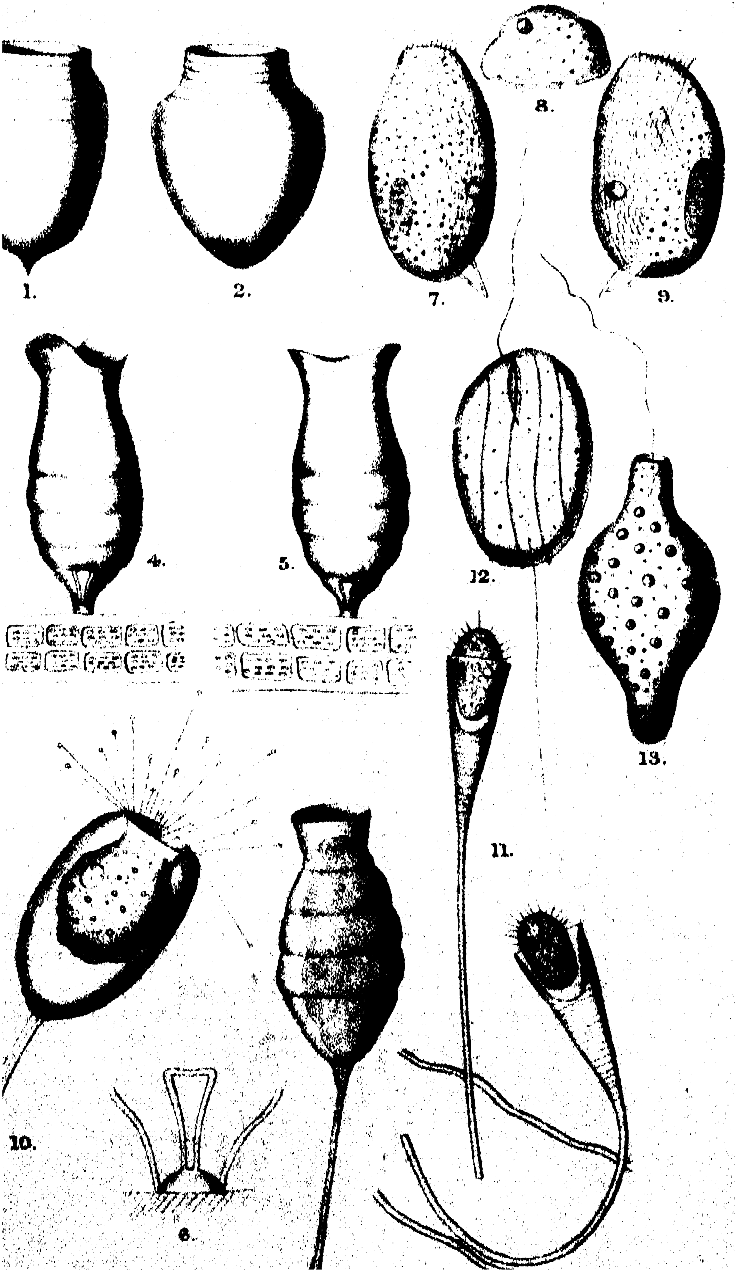

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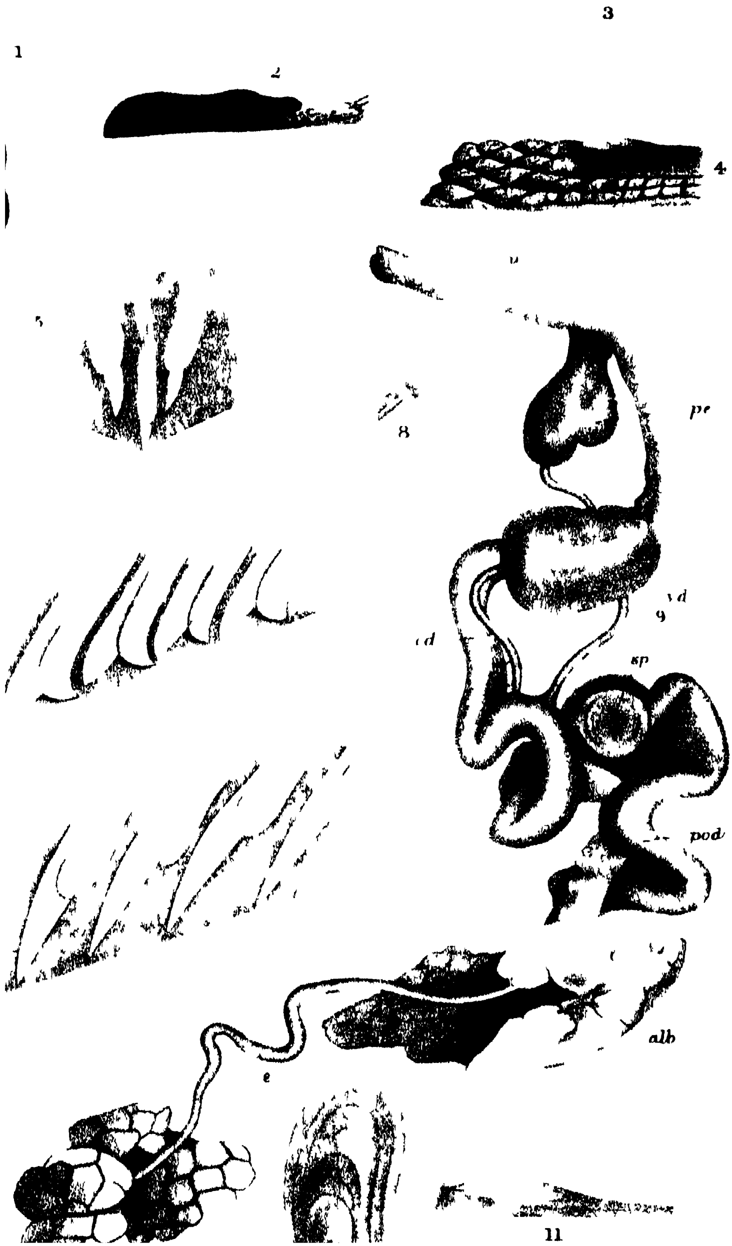

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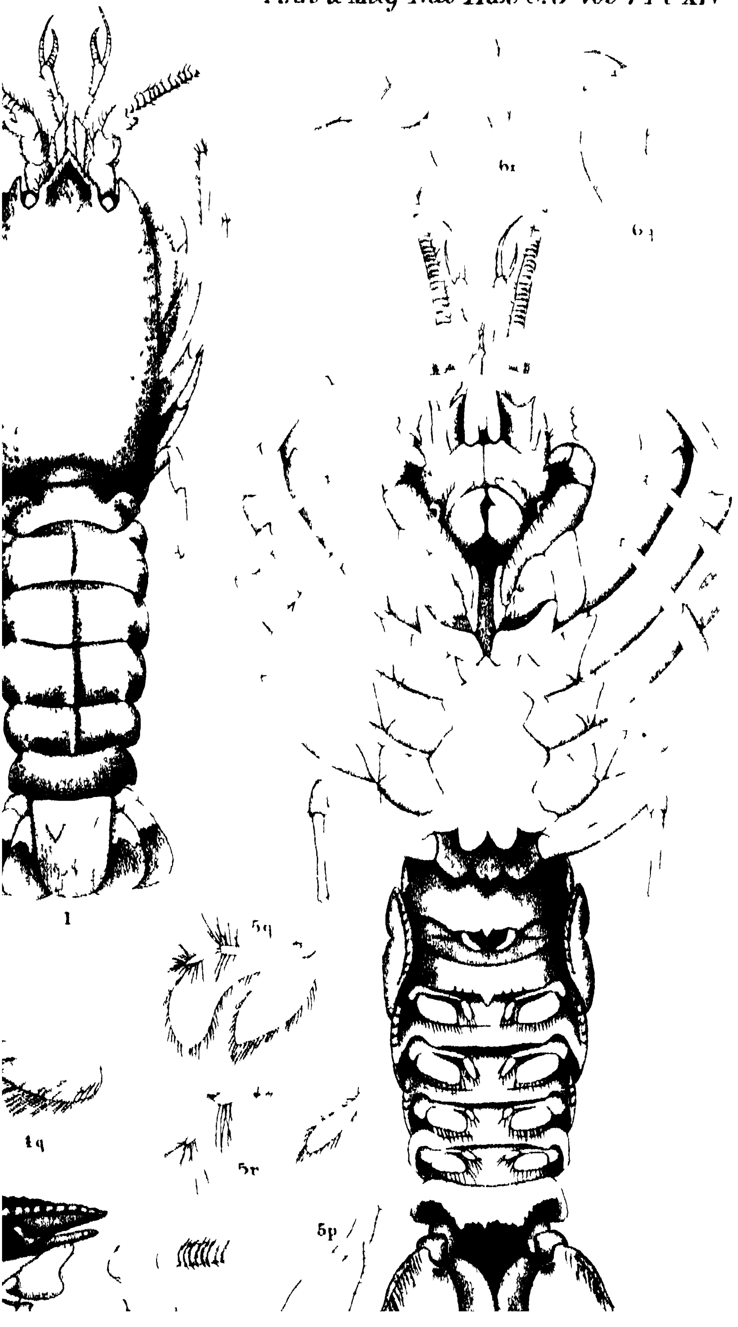
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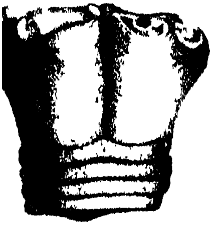

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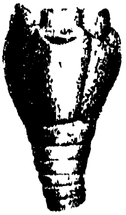

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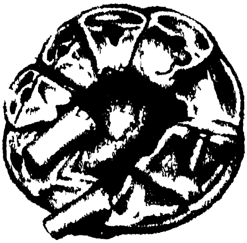

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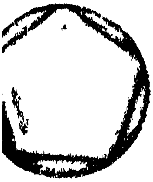

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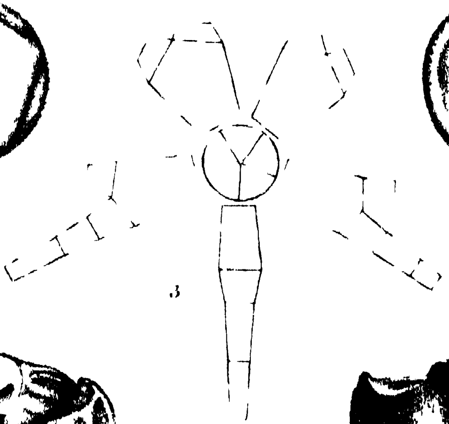

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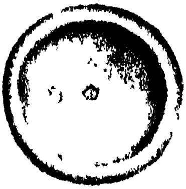

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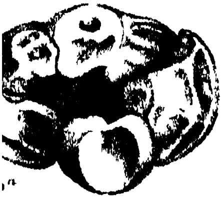

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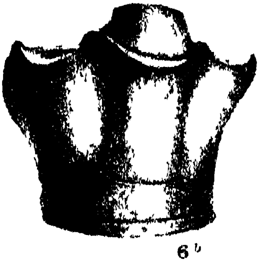

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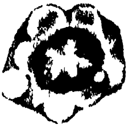

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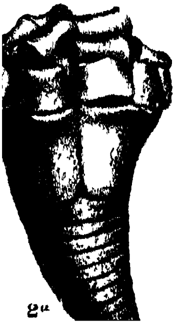

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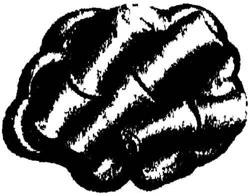

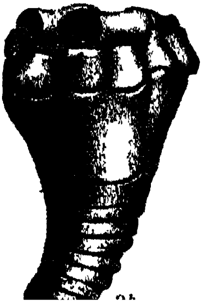

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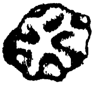

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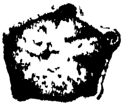

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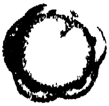

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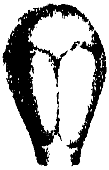

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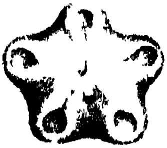

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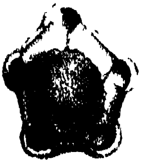

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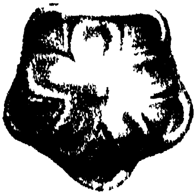

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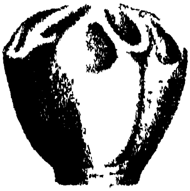

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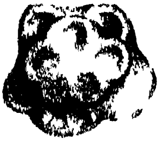

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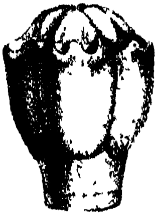

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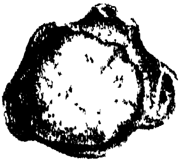

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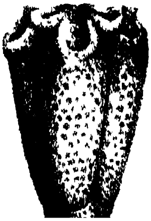

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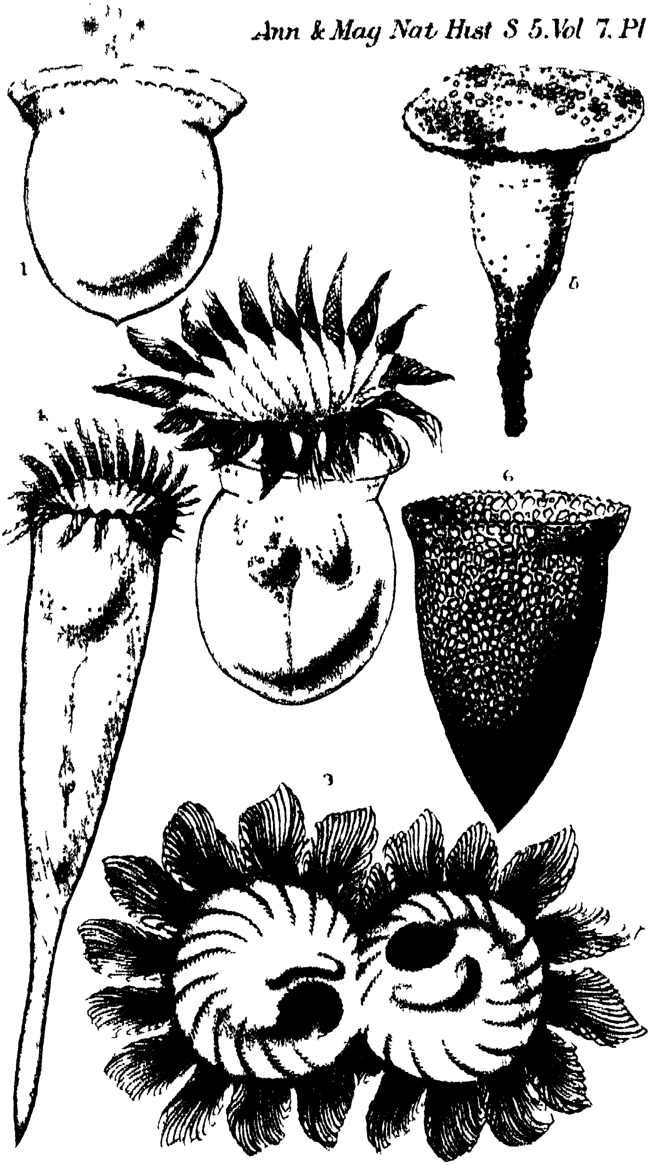

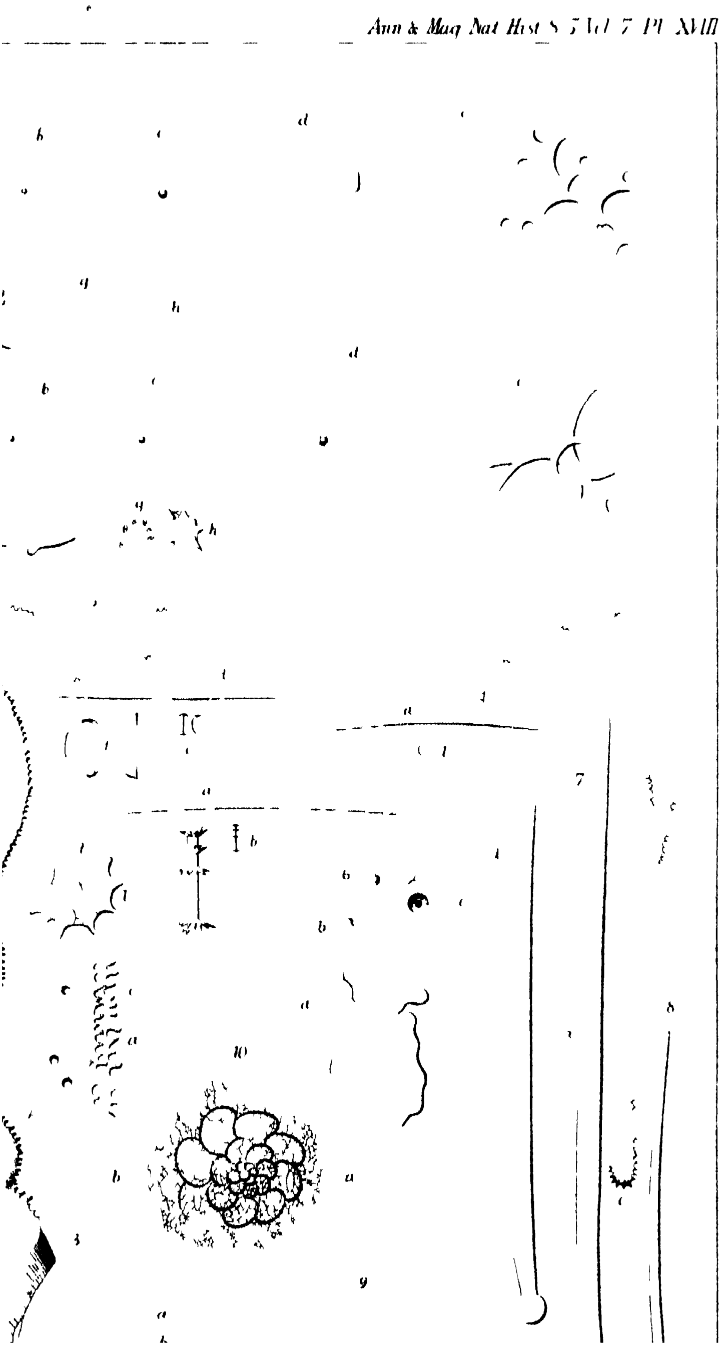
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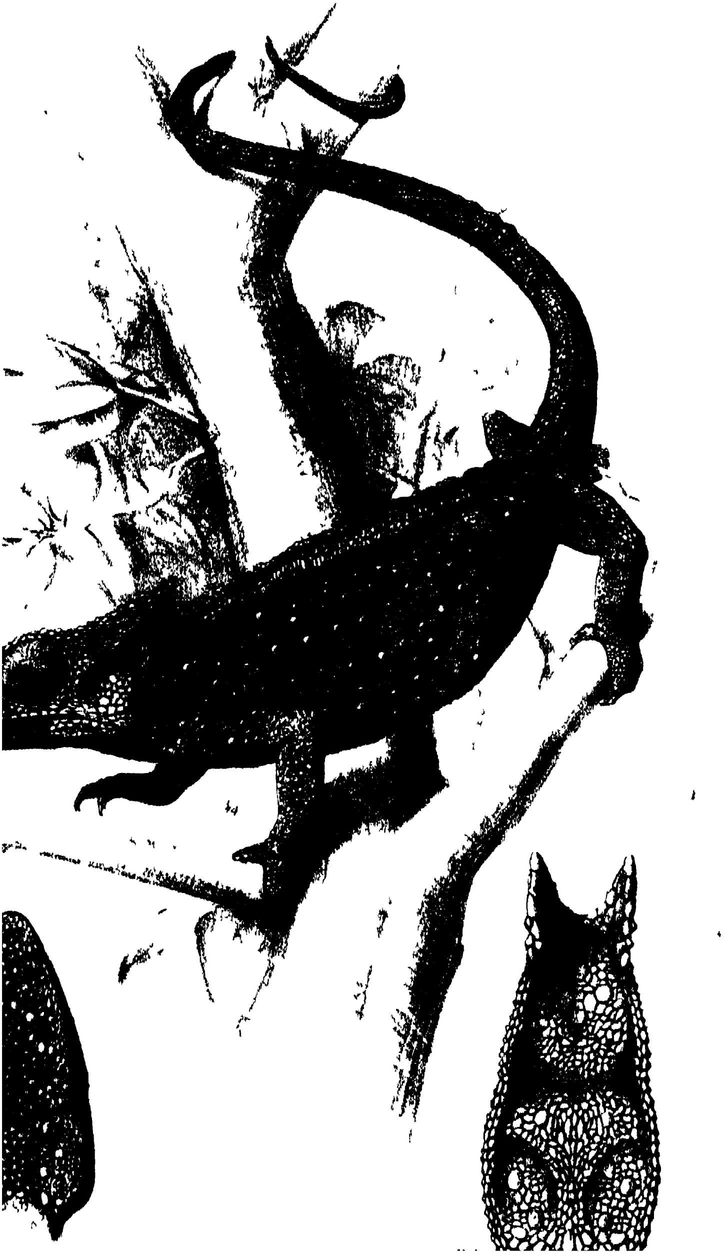

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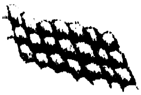
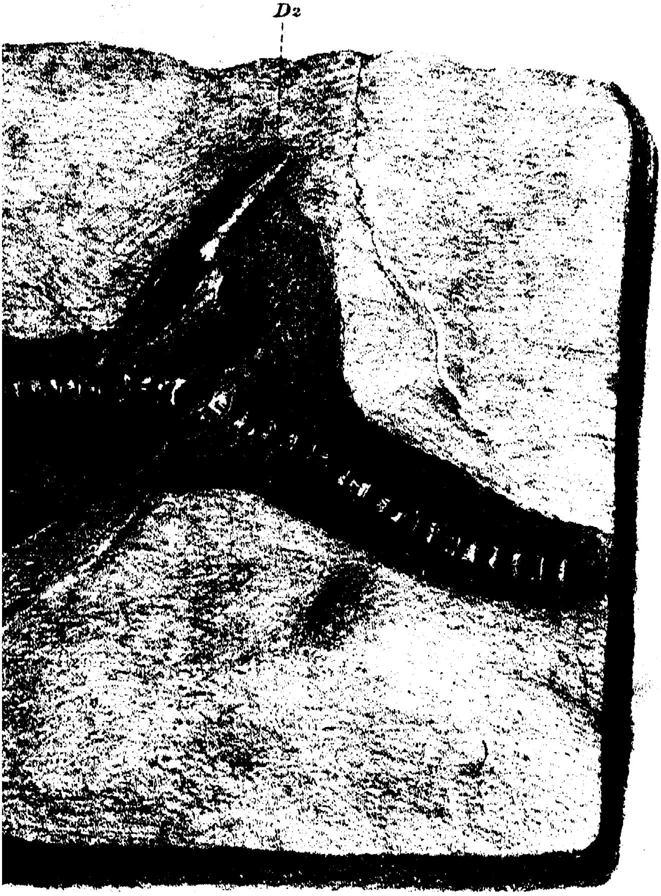




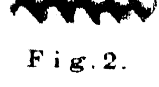
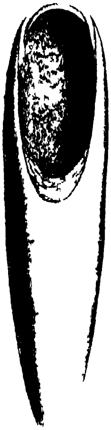


Fig. 2.

Ann & Mag Nat S 5 Vol 7 Pl XXI.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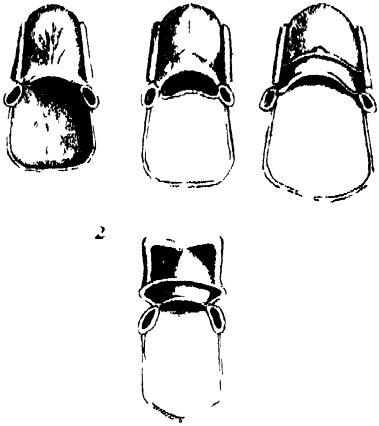
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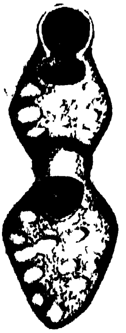
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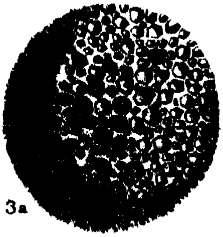
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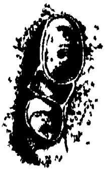
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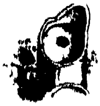
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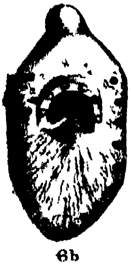
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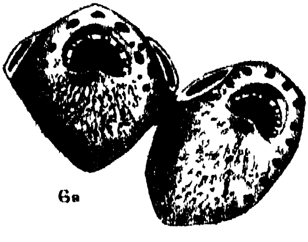
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